THURSDAY, DECEMBER 7, 1905.

THE PRINCIPLES OF HEREDITY.

The Principles of Heredity, with Some Applications. By G. A. Reid. Pp. xiii+359. (London: Chapman and Hall, Ltd., 1905.) Price 12*s.* 6*d.* net.

THE publication of this book marks an epoch in the history of the relation between medicine and biology, inasmuch as it is an embodiment of the recognition by medical men that they depend ultimately for a precise knowledge of nature on the professional biologist—who may or may not, at the same time, be a medical man.

The book should be welcomed by doctors as containing in the earlier chapters a straightforward though rather brief account of theories of organic evolution, and by biologists as giving a very full account of the medical aspect of these problems, and by both as an interesting collection, under the title of "The Principles of Heredity," of a mass of information and ideas connected with that phenomenon.

The reader may object to the antithesis between medicine and biology, but will, we hope, withdraw his objection when it is explained that all that is meant by it is the antithesis between applied and pure biology.

The recognition by medical men of the value to them of the information with which the biologist is able to supply them is unquestionably a good thing; yet it is a curious illustration of the fact that a new movement of opinion cannot stand isolated and alone, cannot be without consequences of one kind or another, that one result of the popularity of the *entente* between the doctor and the biologist may prove harmful to biology, and through it perhaps ultimately to medicine.

The danger is that the biologist, pure and simple, the man who works at his subject for the mere joy of investigation and discovery, may cease to exist. So many workers of this type are becoming applied biologists, whether they be sporozoologists devoting themselves to malaria, students of heredity to eugenics, or cytologists to cancer. We do not, of course, complain of the application of biological knowledge; it is obviously fitting and right that as much use should be made of it as possible. But we do complain loudly of the opinion that the application of such knowledge is, or should be, the ultimate goal of him who acquires it. Huxley strongly insisted on the fact that the fruits, useful to mankind, of the tree of natural knowledge fell unsought for and unexpected on the back of the head of some obscure worker under its shade, and never to him who worked there with outstretched palm. Dr. Reid says, p. 331,

"Hitherto the nature of their training has tended to render medical men excessively conservative. Nevertheless they have already assimilated and put to magnificent practical use one of the two great scientific achievements of the age—Pasteur's discovery of the microbic origin of disease. The other great achievement, Darwin's discovery of the adaptation of species to the environment through natural selection, has hardly been assimilated, and certainly put to no practical use as yet. Both these discoveries should have been made by medical men."

The fact that they were not is an illustration of the truth of Huxley's words.

Let it be emphasised again that we do not hold that the gradual desertion of biologists from the ranks of the pure to those of the applied is other than of the greatest service to mankind. But if this desertion means that the opinion that the natural goal of the young biologist is to obtain a position in applied biology will grow, it is a bad thing for science. So that even if it is only on the ground that the utilitarianism which may lead to the extinction of the pure biologist is a bad one, it is to be deplored. If we are going to be utilitarians let us at least be good ones, and let us recognise the demonstrable fact that the only way in which the knowledge and consequent control of nature can be acquired is by encouraging the existence of the type of man who works at his subject for its own sake. Let us have less of the talk about the profound significance of such and such a branch of investigation to the sociologist and the statesman and more of the frame of mind which finds expression in Bateson's words:—"We are asked sometimes, Is this new knowledge any use? That is a question with which we, here, have fortunately no direct concern. Our business in life is to find things out, and we do not look beyond."

With regard to this utilitarianism Dr. Reid appears to us to steer the right course in his book, except, perhaps, that he sails rather too near it when, pointing out that a classical education is inefficient and does not make us like the Greeks and Romans, he says,

"the true modern representatives of the great Pagans are not to be found in college halls or country parsonages, but in thinkers and workers like Darwin, Huxley, Kelvin, Cecil Rhodes, the strenuous men who rule Egypt and India. . . ."

Surely the patient inquiring spirit which prompts a man to devote himself to classics is the same as that in the heart of the true man of science. One of the greatest steps forward in the study of heredity itself was made by a monk.

Dr. Reid's book is tolerably free from that looseness in the use of scientific terms which is common enough in purely scientific works, but which is simply rampant in books on popular science.

The reader who wishes to familiarise himself with the subject of heredity should be very careful to distinguish between the two meanings of the term regression, the one which is a purely biological phenomenon and the other which is a purely statistical conception. With regard to the use of that much-abused word "law," our author makes a statement that at first sight seems to show that he has not thought very seriously about the meaning of that

word. But we do not believe our author wishes to be taken seriously here:—

"Even if we postulate a Deity as the Originator of all things, yet the whole history of science, which is that of civilisation, proves that it is more profitable to seek the *explanation of natural phenomena in natural laws* (*His laws*) *than in infractions of them*—in miracles." (The italics are mine.)

We have one fault to find; in a work on the principles of heredity one would have expected a fuller discussion than is actually given of biometric and Mendelian methods of dealing with that phenomenon: medical men reading the book will get a very meagre idea of the nature of the investigation being carried on and of the definite results already achieved by these two sets of workers.

Dr. Reid does good service in dealing a blow at that teleology which is the curse of biological science by exposing the falsity of the old idea that the "object" of bi-parental reproduction is to ensure a sufficient degree of variability in each generation for natural selection to operate upon. He cites as evidence for this Dr. Warren's work on *Daphnia magna*; but does not refer to a more recent and more complete demonstration of the same truth by the same author in the case of Aphis, to be found in *Biometrika*, vol. i., p. 129.

These, however, are trifles, and do not detract from the value of the book as a whole. A. D. D.

MATHEMATICAL LECTURES FOR AMERICAN MATHEMATICIANS.

The Boston Colloquium. Lectures on Mathematics. By Edward Burr Van Vleck, Henry Seely White, and Frederick Shenstone Woods. Pp. xii+188. (New York: The Macmillan Company, 1905.) Price 2 dollars net.

Lectures on the Calculus of Variations. By Dr. Oskar Bolza. Pp. xvi+272. (Chicago: The University Press, 1904.) Price 4 dollars net.

AMONG the many ways in which the American Mathematical Society has endeavoured to popularise and develop the study of higher mathematics, not the least remarkable and useful is the practice of holding "colloquia" in connection with the summer meetings at intervals of two or three years. It had been felt that the mere reading of a long string of disconnected papers does not produce much lasting impression on the minds of the audience. On the other hand, even a short course of university lectures will often adequately cover a wide range of mathematical study. The society therefore decided in 1896 to arrange for courses of three to six two-hour lectures, each dealing with a substantial part of mathematics. Four such colloquia have been held, at Buffalo in 1896, at Cambridge in 1898, at Ithaca in 1901, and at Boston in 1903. At each of the first three two courses of lectures were given, and Prof. Oskar Bolza's course on "The Simplest Type of Problems in the Calculus of Variations," given at the Ithaca colloquium of 1901, forms the basis of one of the two volumes before us. The chapters nearly follow the historic order laid down in the introduction, which is also in close conformity with a logical sequence of treatment. The study of the first and second variations of an integral naturally leads to Weierstrass's examination of the conditions for a minimum and the distinction between a "strong" and a "weak" minimum, a terminology introduced by Kneser. The next steps are represented by Weierstrass's theory of parameter representation, Kneser's general theory based on the properties of geodesics, and Hilbert's existence-theorem. For Weierstrass's work (much of which is contained in unpublished courses of lectures) the author has had recourse to his own notes of a course (by Weierstrass) which he attended in 1879, as well as to several other sets of lecture notes, including one on Prof. Schwarz's lectures at Berlin on the same subject.

At the next colloquium, held at Boston in September, 1903, three courses of lectures were given. The year marked the fiftieth anniversary of the appointment of Prof. John Monroe Van Vleck to the chair of mathematics at Wesleyan University, and it was fitting to the occasion that all the lecturers were Van Vleck's pupils, one of them being his son. Prof. Henry S. White, of North-Western University, is responsible for the course of three lectures on "Linear Systems of Curves on Algebraic Surfaces," Prof. Frederick S. Woods, of the Massachusetts Institute of Technology, for three lectures on "Forms of Non-Euclidian Space," and Prof. Edward B. Van Vleck, of Wesleyan University, for six lectures on "Selected Topics in the Theory of Divergent Series and Continued Fractions." A bibliography of literature on continued fractions extending over twenty pages concludes the last named discourse.

Long formulæ involving x and y are like little children—they ought to be "seen and not heard." The success of these colloquia when originally delivered must have been in some considerable measure due to the extent to which the authors have succeeded in dealing with ideas and their symbolical representations without giving tedious demonstrations *in extenso*.

INDUSTRIAL REFRIGERATION.

Modern Refrigerating Machinery, its Construction, Methods of Working, and Industrial Applications. By Prof. H. Lorenz. *American Practice in Refrigeration.* By H. M. Haven and F. W. Dean. Pp. x+396. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 17*s.* net.

IT is to be regretted that no treatise exists on this subject which contains an exhaustive investigation of the thermodynamical problems involved, and of the physical properties of the various gases used as media, with special reference to their practical application to refrigerating machinery. In works on thermodynamics, the matter is treated in general terms. The physical constants are found in scattered

tables, and even with such a well-known gas as carbon dioxide they have not been completely determined. It has become more and more necessary for the engineer or manufacturer to be familiar with the scientific researches and theoretical considerations which lie at the base of his industry, and Germany has come to be looked upon as the leader in fundamental work of this sort, but the "Neuere Kühlmaschinen" of Prof. Lorenz makes no pretence to be of this comprehensive character. While refrigerating machinery is sufficiently simple, the principles on which it is based are not so easy of comprehension to the working engineers and business men who use it industrially. As a handbook for men of this class and as a *résumé* of the subject, this manual has long been known in Germany and on the Continent. Various editions have been published as a volume of the "Technische Handbibliothek," and the present translation under the title of "Modern Refrigerating Machinery" is from the edition of 1901.

No space is taken up by a historical introduction, but after some pages of an elementary character on the principles of heat there follows a chapter on "Methods of Cold Production," which gives a well arranged and concise description of the manner in which refrigeration is produced by different methods and of the energy required. The chapter on compressors treats chiefly of the important details of the machines, and wisely does not touch upon matters which belong more properly to generic and not to special machine design, and has some instructive indicator diagrams. The chapters which follow deal with condensers and evaporators, the cooling of liquids and air, and the manufacture of ice. They describe clearly the chief features of the matter under discussion, and do not enter upon general descriptions from which it is difficult to decipher the essential points. The pages devoted to very low temperatures, written four years ago, have now become merely of historical interest. The final chapter, on the performance of refrigerating machines, or, as the translator calls it, "The Yield of Cooling Machines," contains the only higher mathematics in the book, which contrast rather strangely with some of the simple definitions at the beginning. The translation is poor. The German original is closely followed. Such sentences as "tightness towards gases requires, besides faultless material, as small a number as possible of tubulures and stuffing boxes" are not very clear to an English mechanic, nor does the constant use of italics for the more important words add to the attractiveness of the pages. The illustrations are numerous and excellent, and the cuts are superior to those in the German edition.

In the same volume, though the pages are numbered consecutively, is a separate work on "American Practice in Refrigeration." It contains some admirable illustrations and useful data in regard to the construction of cold storage rooms, but it is not quite apparent what purpose the American authors could have in view in reprinting tables from such well-known books as those of Siebel and Wallis-Tayler.

C. H. B.

OUR BOOK SHELF.

The Geography of New Zealand. By P. Marshall. Pp. x+401. (Christchurch, N.Z., and London: Whitcombe and Tombs, Ltd., n.d.)

THE author claims to have written "according to the spirit of the New Geography," to give due consideration to the influence that the relief of the land has upon the circulation of the atmosphere, the climate, the distribution of flora and fauna, and the settlement of population; he explains that the latter is influenced considerably by the distribution of mineral deposits, while the nature of the industries affects the commerce of the country and shapes its political institutions.

The work is for this purpose divided into three parts, under the headings (1) historical, (2) physical, (3) political and commercial. There is a valuable introduction by Prof. Gregory, and an important chapter on geysers by the same writer, in which, however, he erroneously alludes to Strokur as being still an active geyser, whereas it ceased to erupt in 1895. The chapter on earthquakes by Mr. G. Hogben deserves special mention; the several kinds of earth movements and their registration by the seismograph are described. Of special interest to all lovers of Ao te Roa—the unscientific reader as well as the geographical student—are the chapter on the Maoris, by Mr. A. Hamilton, and the descriptions of various unique natural beauties.

At times the style is very explanatory and the matter original. Occasionally the author's meaning is somewhat vague, as when he writes:—"the high mountainous land here reaches the sea, and is in fact truncated by it." But on the whole the information given is accurate and concise, and the arrangement throughout careful.

As stated in the preface, the book is not merely the result of the author's and his contributors' personal observation, but is a collection of facts and figures from the previous writings of acknowledged authorities on the islands of which it treats. The letterpress is profusely illustrated with maps, reproductions of photographs, sketches, and old prints. These are all interesting, and many of the sketch-maps serve well to illustrate the text.

M. G. B.

Wild Wings; Adventures of a Camera-Hunter among the Larger Wild Birds of North America on Sea and Land. By H. K. Job. Pp. xxv+341; illustrated. (London: A. Constable and Co., Ltd.; Boston and New York: Houghton, Mifflin and Co., 1905.) Price 10*s.* 6*d.* net.

DESPITE its somewhat pedantic title, this book is much above the average of works of the same general nature, and deserves a wide circulation, if only on account of the earnest plea made by its author that the camera may, at least to some extent, be substituted for the shot-gun in our intercourse with birds. In this laudable endeavour he is supported by the President of the United States, who, after stating that wild-game shooting, under proper restrictions and regulations, must be considered legitimate so long as we breed domesticated animals for slaughter, observes that "there is altogether too much shooting, and if we can only get the camera in place of the gun and have the sportsman sunk somewhat in the naturalist and lover of wild things, the next generation will see an immense change for the better in the life of our woods and waters."

The special feature of Mr. Job's book is undoubtedly formed by the illustrations, all of which, we are told, are reproductions—and very excellent ones—of photo-

graphs taken by the author himself. In a country of the size and extent of America, with climates ranging from the arctic to the tropical, and with large tracts of more or less untrodden wastes, the bird-lover and photographer has, of course, vastly greater opportunities (especially among the larger species, to which the author has confined his attention) than his brother in our own islands, and it must be confessed that these opportunities have not been neglected, for a more delightful book, both as regards text and illustrations, it would be difficult to produce.

The breeding colonies of brown pelicans of New England must form a really marvellous sight. On the occasion of the first visit of the author and his party, the boat was run ashore without alarming the birds. "Then," writes the narrator, "we stood up and shouted, but hardly a bird rose. There they sat upon their nests, hundreds and thousands of them, many within forty or fifty feet, solemnly gazing at us. It was not until we sprang out upon the shore that there was any considerable flight, and even then we noticed that it occurred only within a radius of fifty or sixty feet, the rest of the colony remaining on their nests apparently in perfect unconcern." Time after time the colony has been raided by feather and egg hunters, but it is satisfactory to learn that Pelican Island has recently been made by President Roosevelt a Government reserve for wild birds.

Not less interesting is the author's account of the colonies of white ibises and Louisiana herons in the Cape Sable wilderness, this being followed by a fascinating description, with equally fascinating photographs, of the colonies of sooty terns and noddies on "Lonely Bird Key," in the Dry Tortugas group, far out in the Gulf of Mexico. But if we were to cite even a tenth of the passages to which we should like to refer, editorial limits would be far exceeded, and in bringing this brief notice of an admirable bird-book to a close we cannot do better than advise our readers to get copies for themselves.

Instruction in Photography. By Sir W. de W. Abney. Eleventh edition, revised. Pp. 676. (London: Iliffe and Sons, Ltd., 1905.) Price 7*s.* 6*d.* net.

THIS work, which for many years has held the premier position among English text-books of photography, is to a peculiar extent the record of the author's own experiments and investigations, and in the new edition much new matter on the subject of colour photography has been added, the product of the attention which Sir W. de W. Abney has devoted to that branch of photography for some years. In other sections of the book it may be noted that the descriptions of lenses are brought up to date, while the chapter on sensitometry includes a description of Mr. Chapman Jones's plate tester. An entirely new chapter has been added to the book entitled "The Failure of a Photographic Law," and including the well known experiments made by the author upon the effect of intermittent exposures and upon the failure of the reciprocity law. Here also will be found an interesting discussion of the effect of temperature upon the sensitiveness of plates, while the last part of the chapter is devoted to an account of the author's researches upon the effect of different monochromatic lights upon a plate. The book has been entirely reset, larger type being employed throughout and the printing generally improved. No alteration has been made in the theoretical views set forth, and the silver sub-bromide theory of the latent image is adopted in its entirety. C. E. K. M.

La Bobine d'Induction. By H. Armagnat. Pp. 228. (Paris: Gauthier-Villars, 1905.) Price 5 francs.

IN this book a very interesting account is given of the induction coil in its theoretical and practical aspects. The electromagnetic problems involved are clearly stated, and the various factors which stand in the way of a complete mathematical theory are considered in some detail. The effects of sparking at the interruptor, the parts played by the iron core, by the secondary capacity, &c., are carefully examined and methods of experimental investigation are illustrated. The differences between mechanical and electrolytic interruptors are discussed, and the more purely theoretical part of the book concludes with a chapter on the power and output of a coil and of the factors upon which these depend. The methods of measuring the electromagnetic constants of a coil are indicated, as are the most common sources of breakdown, how they may be detected, and how in some cases remedied.

In the description of the practical construction of coils which follows, the different methods of winding, insulation, &c., are described in detail, and the relative dimensions of the various parts of coils of standard makes are given. The particular features of different types of interruptors, mechanical and electrolytic, upon which efficient working depends are stated clearly (although the action of the commonest mechanical interruptor is not quite so simple as it is made to appear, and might perhaps have been described in greater detail in a book of this kind).

The principles of the action of several special forms, such as Tesla's, of induction apparatus used in practice are given in outline, and a final chapter is devoted to a description of the various uses of induction coils. The range of this chapter is perhaps indicated when it is said that it includes the discussion of such questions as the ignition apparatus of explosion-engines and the production of ozone.

A very useful bibliography, in which the references are in most cases accompanied by short abstracts, completes an excellent book.

Handbook of Metallurgy. By Prof. Carl Schnabel. Translated by Prof. Henry Louis. Second Edition. Vol. i. Copper—Lead—Silver—Gold. Pp. xx+1123. (London: Macmillan and Co., Ltd., 1905.) Price 25*s.* net.

THIS volume is a translation of the second German edition which appeared in 1902. Prof. Schnabel has found it necessary to increase the length of the book considerably, the translation being 214 pages longer than that of the first edition. A number of new furnaces and other appliances are described, and in particular the account of the extraction of copper by electro-metallurgical methods has undergone great expansion. The older metallurgical methods are purposely dwelt on by the author, who gives as his reason that a knowledge of the development of metallurgy stimulates inventive genius. It is equally certain that the inclusion of the descriptions of out-of-date methods helps to make books bulky.

The merits and defects of the book remain much the same as in the first edition. It contains a mass of detailed information as to the dimensions of appliances in use at particular works, the analyses of products, and the like, but the discussion of the principles underlying the practice is generally less thorough. This is as much as to say that the book is "practical." Prof. Louis is to be congratulated on the translation, which makes a valuable work available to British students.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Second Law of Thermodynamics.

THE point which Mr. Browne (p. 102) raises is covered by Voigt ("Thermodynamik," vol. ii., § 69, pp. 209 *et seq.*). Ordinary diffusion of two gases at equal pressure and temperature is an irreversible process involving loss of available energy, but when the diffusion takes place through porous membranes this available energy can be utilised in a greater or less degree in the form of work, and this is the case in Mr. Browne's experiment. By introducing the conception of "semi-permeable partitions," Voigt obtains a reversible method of mixing or separating gases. In this case the partial pressure of the mixture is equal to the sum of the partial pressures of the components. In ordinary diffusion the volume of the mixture is equal to the sum of the volumes of the components. The work of expansion from the former to the latter final state can be utilised if a reversible transformation is employed. It is lost in the case of ordinary diffusion. An equal amount of work must, however, be supplied from without to separate the gases. The results are fully in accordance with the second law. G. H. BRYAN.

MR. M. A. BROWNE'S letter (p. 102) raises an interesting and difficult question which at some period of his career must be faced by every student attempting to grasp for himself the significance of the second law of thermodynamics. As I, with difficulty and without much help from the text-books, extricated myself from a similar dilemma, perhaps the steps in the train of reasoning which helped me may interest others.

There is no need to take the complicated case chosen by Mr. Browne of the diffusion of hydrogen and nitrogen through a palladium septum. A precisely analogous difficulty exists in the simpler case of an ordinary cylinder of compressed gas doing external work on expansion either at the expense of its own heat or of the heat of uniform temperature of its environment. The gas expands and does an amount of external work W, while the equivalent H units of heat flow into the gas from the surroundings, so that the result of the process is that H units of heat at the uniform temperature of the surroundings have been quantitatively converted into external work. This is, no doubt, contrary to many of the earlier statements of the second law.

The test, of course, is to compress back the gas into the cylinder, when at least W units of work have to be converted back into heat during the process. Moreover, this must be done whether or not the gas did work on expansion. Although a gas expands freely into a vacuum, doing no work, and, as Joule has shown, experiencing no appreciable change of total energy in the process, to get it back again into the cylinder, at least W units of work must be converted into heat. I know of no better way of introducing thermodynamical considerations to the chemical student than by commencing with the concrete case of a gas cylinder. The extension of the same considerations to all processes naturally occurring, the flow of heat from a hot to a cold body, the diffusion of gases through septa, the change of one allotropic form of element into another, all follow as illustrations of the "majestic" and "universal" law that that mysterious something which is not energy, but an abstraction of energy—its availability for work—tends always to a minimum, or, as others have it, the entropy increases. The student passes his examination, no doubt, but if he is a philosopher he may prefer to meet his difficulties singly, and not have them "concentrated in a phrase." It is possible that he may like to think sometimes of a gas as expanding, because it is its nature to. The reason is easily understood on mechanical or kinetic considerations. But the attempt to replace these considerations by the two *ex cathedra* statements—(1) the entropy of a gas increases during increase of volume, (2) the entropy of the universe tends to increase—and to deduce from them the direction of natural tendency in the case of a gas changing in volume, seems to the writer to involve the thermodynamical equivalent of the fallacy of "putting the cart before the horse." We cannot escape mechanical and molecular considerations.

The University, Glasgow. F. SODDY.

Atomic Disintegration and the Distribution of the Elements.

WITH reference to the association of uranium and radium, would you permit me to put on record a point that must have occurred to many, though possibly not to some, of those who are speculating so brilliantly about uranium and its disintegration products. I refer to the extraordinary conjunction in nature between silver and lead. This conjunction is so frequent that it can hardly be casual. A lead mine is a silver mine and a silver mine a lead mine all the world over, and yet the chemical attraction between silver and lead is slight, and the two metals are not sufficiently common to concur by chance. It is to be noted also that the concurrence, if the word may be used in this sense, is usually of the order of ounces for silver and tons for lead, and that the atomic weight of lead is 207 and of silver 108. Hence there appears to be some ground for the suspicion that silver is a disintegration product of lead. Lead also happens to present special facilities for experiment to test this surmise. It is cheap, and it is a comparatively inexpensive matter to free ten tons of lead from all traces of silver by the usual crystallising process, and then put it aside for ten years and test again for silver by the same process.

There are several other curious groupings of elements in nature that seem to be worthy of consideration from the transmutation point of view. One of these is the frequent concurrence of copper and gold. In the Great Cobar copper mine in New South Wales the gold occurs in the ratio of about four ounces to the ton of copper. Such conjunctions as gold and quartz are, of course, easily explained by chemistry and coincidence, and chemical forces also sufficiently explain the concurrence of sulphur with silver and lead, but the giant deposits of silver, lead, and zinc, with smaller quantities of copper and still smaller quantities of gold at Broken Hill, in Australia, to say nothing of similar vast deposits in many other countries, can hardly be due entirely to chemical and casual forces. Anyone interested in the subject will find much statistical and other information in the annual report of the Broken Hill Proprietary Company. This document affords considerable food for reflection, and a visit to the mine itself is absolutely awe-inspiring. Walking through galleries of glittering grey crystals of silver, lead, and zinc sulphide—solid ore—for 300 feet *across* the lode, which is a mile or more in length and of unknown depth, is one of the experiences of a lifetime. DONALD MURRAY.

3 Lombard Court, London, E.C., November 30.

Zoology at the British Association.

IN your account, under the above heading, of the proceedings of Section D of the British Association at Johannesburg, you state (p. 40) that in my paper on Cephalodiscus I "gave a preliminary account of the new species discovered in African seas by Dr. Gilchrist."

I shall be obliged if you will allow me to say that my communication to Section D consisted of an abstract of the results which were published, last July, in my report on "The Pterobranchia of the *Siboga* Expedition," and that it did not include any account of Dr. Gilchrist's specimens of Cephalodiscus. S. F. HARMER.

King's College, Cambridge, November 14.

[Our contributor was unfortunately engaged in the committee room during Dr. Harmer's introductory remarks, and this led to the misunderstanding to which Dr. Harmer directs attention.—EDITOR.]

THE THOROUGHBRED HORSE.[1]

THE re-discovery of the so-called *Equus przewalskii*, or Mongolian wild pony, has during the last few years awakened renewed interest in the puzzling question of the origin and ancestry of our domesticated breeds of horses and their relations to their wild or semi-wild representatives, and workers on both sides of the Atlantic have been doing their best, with results more or less satisfactory (at least to themselves), to solve the problem. The subject, like an apparently impregnable fortress, has been attacked from several sides at once, in the hope that if one plan fails another may succeed; and while one worker has endeavoured to solve the mystery by the study of apparently vestigial structures, a second relies on cross-breeding, while a third believes that external characteristics are alone sufficient to decide the question. Prof. Ridgeway, on the other hand, has primarily attacked the problem from the point of view of the historian and the archæologist, and it must be acknowledged that naturalists owe him a large debt of gratitude for bringing into prominence lines of evidence with which, from the very nature of the case, they are unfamiliar. Apparently, however, the author soon discovered that salvation was not to be found from archæological investigations alone, and that it was essential for him to enter in some detail into the natural history of *Equus caballus* and its allies. To one who has thus been compelled by force of circumstances to enter on paths of study other than his own, tender treatment should be accorded by the critic, and especially should this be so in the present instance, when the author has called to his assistance at least two naturalists who have specially studied the Equidæ.

FIG. 1.—Norwegian ponies, as examples of the typical dun type of the horse. From Ridgeway's "The Thoroughbred Horse."

As regards the two introductory chapters on the horse family in general, a very large proportion has little or no bearing on the subject, and might advantageously have been omitted. As it stands, it is to a great extent inaccurate and misleading. If, for instance, the list of existing Equidæ on p. 12 be compared with the descriptions of species and races later on, numerous discrepancies will be found. As an example we may refer to the mention of the chigetai, or dzeggetai (*Equus hemionus*), and of the kiang (*E. hemionus kiang*) on pp. 44 and 45, and the complete omission of the former on p. 12, where the latter is quoted as *E. kiang*. The difference between species and subspecies is, however, a great stumbling block to the author, as may be inferred from p. 61, where it is stated that "certain zebras have been made into subspecies by some, though there is no evidence that they are more than local races," and we are left in pleasing uncertainty whether the wild Mongolian pony is a species by itself or a race of *Equus caballus*. In connection with this part of the subject, the omission of any reference to the present writer's latest paper (1904) on wild asses, when his earlier ones are quoted, is noticeable, as is also the statement (p. 143) that he has sought to establish a relation between the ponies of Java and Sulu and *E. sivalensis*. Perhaps too much is also made of the expression "an Indian domesticated horse" in reference to a certain skull (pp. 159 and 470) in the British Museum, which probably belonged to an imported animal. Strong exception must be taken to certain statements, even if they be quotations, connected with fossil Equidæ. It may or may not, for instance, be admitted that the horses of Asia and Europe have an American ancestry; but to state (p. 10) that *Equus stenonis*, the earliest European fossil horse, was one of the earlier immigrants, and that while this species "was extending its range into Europe and Africa, two others, *E. sivalensis* and *E. namadicus*, were finding their way into India," is neither more nor less than nonsense, more especially since the Indian *E. sivalensis* is at least as old, if not older than any known American true horse!

It is time, however, to take into consideration the author's views as to the chief existing types of horses, which appear to be as follows:—First of all we have the "typical horse," that is to say, *Equus caballus typicus*, which we presume must be taken to be the ordinary Scandinavian pony (Fig. 1), although the author does not commit himself upon this point; secondly, the Celtic pony (*E. c. celticus*) of Iceland, the Hebrides, and other parts of north-western Europe; thirdly, the tarpan and Mongolian wild pony, which we may agree to call provisionally *E. c. przewalskii*; and fourthly, the Barb, Arab, and thoroughbred stock, for which the author proposes the name *E. c. libycus*. All the first three appear to be closely allied, and are typically small animals with large heads, short manes, and tails often imperfectly haired at the base, while their general colour is dun with black points. In temper they appear to be intractable, and when first domesticated they seem to have been broken to harness instead of for riding, and to have been controlled with the bit. The Norwegian pony is believed to have considerable intermixture of

[1] "The Origin and Influence of the Thoroughbred Horse." By W. Ridgeway. Cambridge Biological Series. Pp. xvi+535; illustrated. (Cambridge: The University Press, 1905.) Price 12*s*. 6*d*. net.

southern blood, and if we allow for this it may be asked whether there is sufficient justification for separating the "Celtic pony" as a distinct race, and whether both do not consequently come under the designation of *E. caballus typicus*. If he be right in identifying the original unaltered tarpan with the Mongolian wild pony (*przewalskii*), the author has done good service, as he certainly has in pointing out that the mouse-colour of the tarpan in the Moscow Museum is a sign of hybridism. Whether *przewalskii* might not also be included under the name of *E. c. typicus* is another question that may be left open.

Turning to the author's fourth type—the Barb, Arab, and thoroughbred—we find this standing out in marked contrast to all the above, so that in any case we have two main groups of domesticated horses. The Barb type, as it may be called for brevity, is a larger horse than the dun northern type, with a more delicate, although long, head, prominent nostrils, curiously sinuous profile, full and profuse mane and tail, a colour which appears to be typically bay, relieved frequently by a white star on the forehead and one or more white "stockings." The occurrence of a depression in front of the eye-socket (whether a remnant of the ancestral face-gland, or, as some suppose, a point for muscular attachment is immaterial) in the skull is admitted as a characteristic of this type. From their large size these horses were from the first used for riding, while their gentle disposition led to their being dominated by a nose-band instead of a bit. All the dark-coloured horses of Europe, notably the Shire horse, are believed to have a more or less strong infusion of Barb or Arab blood, which is, however, most predominant in the thoroughbred.

In thus dividing domesticated horses into two main types, the northern dun and the larger southern bay, Prof. Ridgeway will, we think, command the consent of most naturalists. Whether, however, he is right in regarding the full mane and tail of the Barb type as an original feature and not one largely due to domestication may be an open question. Doubt may be also legitimately entertained as to whether he is justified in making North Africa the birthplace of the bay type. In the first place, there arises a suspicion that he has been biased by a former theory (now happily abandoned) that the Barb type is the descendant of the Somali zebra (*Equus grevyi*). Putting, however, this aside, it may be pointed out that the author does not appear to give sufficient weight to the fact that true wild horses are utterly unknown in Ethiopian Africa, and that northern Africa is but a small outlying part of the Holarctic region, the fauna of which is to a great extent identical with that of southern Europe and western Asia. On these grounds, although we may admit that the true Barb was the earliest representative of the bay type to be domesticated, it seems extremely improbable that the ancestral, and now extinct, form of this race was confined to North Africa, while it is much more likely that it ranged over a large extent of south-western Asia in prehistoric times.

To follow the author in his extremely interesting survey of the spread and modification of the domesticated horse during historic times is unfortunately quite impossible within the limits of our available space, and we can only say that it will repay careful reading. The early existence of the Barb type is indicated by a figure of a Libyan woman riding one of these horses, taken from a vase dating between 664 B.C. and 570 B.C.

In conclusion, the present reviewer, who has been so largely quoted (and by no means in an altogether friendly spirit) throughout the work, may perhaps be permitted a few lines in which to explain his own views on certain points. In the first place, he is affirmed to have definitely assigned India as the birthplace of the bay or Barb type; but reference to the original article (*Knowledge and Scientific News*, August, 1904, p. 174) will show that he merely suggested the derivation of the "thoroughbred and eastern breeds generally . . . from an extinct Indian species, *E. sivalensis*." It is true that the expression "eastern breeds generally" is somewhat too extensive, but it was meant to apply primarily to Turks and Arabs; while as to *E. sivalensis*, the writer would be the last to suggest that its range was limited to India, and that it might not have had a wide distribution in Asia. In assigning the origin of the Barb type to this or an allied fossil species rather than to the European *E. stenonis*, which likewise presents a pre-orbital depression in the skull, the reviewer was influenced by the fact that the latter is definitely known to have been succeeded in the prehistoric and Pleistocene deposits of north-west Europe by horses which lack that feature. Moreover, if, as Prof. Ridgeway urges, the northern dun and the southern and eastern bay types are essentially distinct, what is more likely than that they should have been respectively derived from Pliocene types of which one is northern and the other eastern and possibly southern? As regards the main thesis—the existence of the two aforesaid main distinct types of domesticated horses—the reviewer is in perfect accord with the author of the work before him. R. L.

SIR J. S. BURDON-SANDERSON, BART., F.R.S.

ON Thursday, November 23, in his seventy-seventh year, this distinguished man passed quietly to his rest after a protracted illness of some months. His death removes from the University of Oxford one of its greatest personalities, whilst biological science, especially those branches immediately associated with medicine—physiology and pathology—has suffered an irreparable loss. The remarkable tribute contained in the *British Medical Journal* issued on December 2 shows the extent to which those who are now working at these subjects honoured and reverenced him as their master.

He was born at Jesmond, Northumberland, in December, 1828, being connected on both his father's and his mother's side with men of great distinction; the details of his ancestry are cited in Mr. Francis Galton's hereditary notes as one instance of those family histories which show extraordinary mental capacity or remarkable achievement distributed along the ancestral line. He was never at a public school, but was educated at home in that border county which he always loved, and throughout his life he manifested a special delight in sunlight, stretches of wild moor, mountain streams, rocks, heather, wild flowers, and wild birds. His powers of observation and the interest with which he regarded all natural objects were such that he might have become a great naturalist, but his bent was evidently towards medicine, and his parents, relinquishing their own bias for the legal profession, sent him to Edinburgh for a course of medical training. Goodsir and Hughes Bennett were then the professors of anatomy and physiology, and the latter seems to have exercised great influence on the future physiologist, turning his thoughts to cells and their living processes.

He soon showed some of those characteristics which stamp indelibly the scientific work of his life. Thus,

an entry in the minutes of the students' scientific meetings (Royal Medical Society) of 1850 states that a dissertation was read by John Scott Sanderson, of Newcastle, on vegetable irritability, and his first publication in the *Edinburgh Monthly Journal of Medicine*, 1851, was a criticism of the views held at the time as to the metamorphosis of the coloured blood corpuscles, founded on numerous experiments and observations made by himself. After his graduation in medicine he left Edinburgh and went in 1851 to Paris in order to study chemical methods under Wurtz. Associated with him were several Edinburgh student friends, including Marcet and Pavy; he was soon attracted by the fame of Claude Bernard, whose demonstrations he attended, and by whom he was introduced to Magendie. On his return to England in 1853 Burdon-Sanderson married Miss Herschell (whose brother subsequently became Lord Chancellor), and set up in London as a practising physician, being also attached to St. Mary's Hospital as medical registrar. His wide knowledge and great capacity were immediately recognised, and he was made lecturer in botany and afterwards in medical jurisprudence at the medical school of this hospital.

An opportunity for the display of his powers on a larger scale came in 1856, when he was appointed Medical Officer of Health for Paddington. This office he retained for eleven years, during the last seven of which he held, in addition, the responsible position of Inspector in the Medical Department of the Privy Council, where he became closely associated with one who became his great friend, the late Sir John Simon.

From 1870 his work became more and more identified with experimental investigation along physiological lines, his aim being the more exact study of the reactions of the body tissues in health and in disease. Pathological inquiries were, in his judgment, to be conducted in the spirit, and by the experimental methods, which obtained abroad in connection with physiology, and which he had followed for two years under Claude Bernard. It is the practical application of this physiological view which gives his pathological work such transcendent importance, for in the 'seventies he was the only English pathologist who dealt with the subject in a way which is in accordance with modern methods. A most important outcome of this endeavour to investigate disease by the use of experimental and strictly scientific methods was the bringing over of Dr. Klein to this country.

As assistant professor to Dr. Sharpey in University College, London, from 1870 to 1874, and still more as full Jodrell professor of physiology from 1874 to 1882, he exercised a profound influence upon the advance of medical science. One important aspect of this influence is the revolution which has been effected in the methods of teaching physiology; this was inaugurated by his organisation of class work for practical physiological chemistry and for carrying out simple experiments upon excitable tissues, muscle, nerve, &c. Such practical work, now a conspicuous feature of all academic physiological teaching, was initiated by Burdon-Sanderson, who insisted on its importance, not merely for its obvious educational utility in implanting a knowledge of fact and method, but still more for its value as a means of cultivating powers of observation and inference.

In 1882 he acceded to an urgent request that he should come to Oxford as the first Waynflete professor of physiology. He decided on this course because he believed that it was for the highest interests of medical education, the medical profession, and the public, that the University of Oxford should regain the great position which she once held in regard to medicine. As professor of physiology for twelve years, and then as Regius professor of medicine for nine years, he laboured consistently for this end, and, as his life drew to its close, he had the supreme satisfaction of realising that the end had been practically attained. Departments of human anatomy, physiology, and pathology, efficiently equipped and under competent professors, form the material witness of this achievement, but the students who have passed through the scientific medical course at Oxford furnish still more cogent evidence of the great resuscitation which he has brought about; for Oxford this is his enduring monument.

Sir John Burdon-Sanderson was so distinguished as a scientific man, and conducted important investigations in so many branches of medical science, that it is possible in the space of this memoir to make only a brief reference to the most conspicuous of his researches. As regards the whole of his physiological and pathological work, extending over a period of nearly fifty years, certain features stand out prominently. His adoption throughout of experiment as the only fruitful method; his belief that "no real advance could be made until it became possible to investigate the phenomena by methods approaching more or less closely to those of the physicist in exactitude"; his constant anxiety that attention should be focused upon the processes which are observed in living tissues, whether normally present in health or modified in disease; and finally his conviction that all such processes, observed either in isolated tissues or in particular organs of the body, are to be regarded as exhibited because they are inexorably linked with the interests of the whole organism of which the particular structures form a part—natural selection in its widest sense.

In practical medicine his desire for exactitude led him to invent the stethograph for obtaining mensurable records of the respiratory movements of man, and to modify Marey's sphygmograph in order to obtain such records of the arterial blood pressure.

In pathology he employed similar exact methods for the investigation of the inflammatory process and of infective diseases, particularly tuberculosis, pyæmia, and septicæmia. His reports to the Privy Council, and his other publications on these subjects, reveal conceptions as to the character of the processes involved in disease, and of the nature of the response of the normal tissues to infective introduction, which are still far ahead of the general knowledge of the present day, and are viewed from the standpoint, in all essentials, of the modern pathologist. A remarkable instance of this is furnished by his early work on immunity, a subject which, in its recent development, has acquired an importance for the health of the community which it would be difficult to overestimate. Thus, three years before Pasteur published his celebrated work on the subject, Burdon-Sanderson showed that anthrax virus could be attenuated by its transmission through the bodies of rodents, and suggested that it might be possible, by using the attenuated virus, to confer protection against the disease.

In physiology he carried out from 1871 to 1878 experimental inquiries upon the mechanism of circulation and of respiration, made an extensive investigation as to asphyxia, and was the first to show that the nerve fibres in the corona radiata of the cerebral hemispheres would, when locally excited, give rise to definite body movements. But his main work dealt

with the fundamental characters of those elementary processes which are displayed by the excitable tissues of both animals and plants when their activities are aroused by definite stimulation; he thus returned to the topic which had attracted him during his student life at Edinburgh. The published researches of his later years on this subject have become models for all subsequent work, commanding admiration on account of the completeness of their design, and carrying conviction through the security of their foundation, which rests on the solid ground of mensurable records. The electromotive phenomena displayed by active tissues appeared to him to furnish the most trustworthy of such records, provided that appropriate instrumental methods were employed in their investigation; these he made every effort to utilise, and for this end he introduced into physiological method the recording capillary electrometer. His publications on the electromotive phenomena of the beating heart, on similar phenomena in the excitable leaves of the Dionæa plant, in voluntary muscle, in the electrical organs of fishes, &c., are examples of his activity in this field.

In the last year of his life he was still engaged upon this engrossing subject, and was planning and supervising investigations for the further elucidation of the electromotive phenomena present in muscle when thrown reflexly into activity. This piece of work, and others on various subjects of like nature, remain in an unfinished state, but, though fragmentary, they are so suggestive that it may be hoped they will be included in a future collection of his numerous scientific papers.

In conclusion, reference must be made to that commanding influence which true greatness exerts over other scientific workers, moulding their thought, stimulating their powers, and enriching their lives. The factors which contribute to the wielding of this influence defy precise definition, since, apart from acknowledged achievement in science, their essence is to be sought for in certain mental, moral, and physical qualities. In Burdon-Sanderson's case conspicuous traits stamped him as a leader of men, for his inspiring personality, his extraordinary charm of manner, and his wonderfully expressive face made a profound impression even on those whom he casually met. But his students, using the term in its largest sense, were conscious that the real impression made upon them was the work of more potent factors; his courtesy to even the humblest worker, the sympathetic interest with which he followed all experimental work, the breadth of his view, the profundity of his knowledge, ever placed ungrudgingly at the disposal of everyone who sought his help, the genuine character of his devotion to scientific truth, and the unwavering firmness with which he advocated the use of experimental methods. All these combined to attract and hold the younger physiologists and pathologists, and since they realised that it was a delight to him to mix with younger men the influence he exerted was profound. He often expressed his intense satisfaction at the vast change of which he had been a witness, a change which has in thirty years advanced British physiology and pathology into the first rank. The name of Burdon-Sanderson will be permanently associated with this extraordinary advance, for it is generally recognised that by work, example, and precept he has contributed in a very special degree towards the creation in this country of that vigorous band of workers who have given English medical science such a wide reputation.

F. G.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on Thursday, November 30, when the report of the council was presented, the president delivered his address, and the new council already announced (p. 33), for the year 1906, was elected. In the evening the anniversary dinner was held at the Hotel Metropole, Lord Rayleigh, the newly-elected president, being in the chair.

The report of the council refers, among other subjects, to the Royal Society Catalogue of Scientific Papers, the International Catalogue of Scientific Literature, the Meteorological Office, tropical diseases, Antarctic work, seismology, the International Geodetic Association, Indian Trigonometrical Survey, Astrographic Chart, and the National Physical Laboratory. A few matters recorded in the report have not been announced or described in these columns, and may therefore be mentioned here.

At the beginning of August, the Treasury expressed willingness to place on the estimates a sum not exceeding 200*l.* as an annual national contribution toward the expenses of the central bureau of the International Seismic Organisation should the adhesion of Great Britain to the international scheme be agreed to. On November 2, the council, having received a report on the subject from the Society's seismological committee, agreed to recommend that H.M. Government should join the organisation, and advised that Prof. Schuster be appointed the representative of this country to the organisation. The Treasury has agreed to the continuation by Great Britain of its adherence to the Geodetic Convention of 1895 for a further period of ten years from January 1, 1907, and to a payment during that period of an annual subscription of 6000 marks. Also, at the instance of the Royal Society, the Treasury has undertaken that one-half the cost of printing the British section of the International Astrographic Catalogue executed under Prof. Turner's direction, within a limit of 1000*l.*, shall be met from public funds.

The report of the council concludes with an expression of appreciation of Sir William Huggins's services to the Society during the five years in which he held the office of president, and the announcement that Lord Rayleigh had accepted nomination as his successor.

In his presidential address, Sir William Huggins dwelt upon the influence which discoveries of science have had upon the general life and thought of the world, especially during the past fifty years, and the place that science should take in general education. Some extracts from the address are subjoined:—

The influence of science during the last fifty years has been in the direction of bringing out and developing the powers and freedom of the individual, under the stimulation of great ideas. To become all that we can become as individuals is our most glorious birthright, and only as we realise it do we become, at the same time, of great price to the community. From individual minds are born all great discoveries and revolutions of thought. New ideas may be in the air and more or less present in many minds, but it is always an individual who at the last takes the creative step and enriches mankind with the living germ-thought of a new era of opinion.

All influences, therefore, and especially all laws and institutions which tend to lose the individual in the crowd, and bring down the exceptional to the level of the average, are contrary to the irresistible order of nature, and can lead only to disaster in the individual and in the State.

I should not omit to mention the marvellous secondary effects of scientific discoveries upon the mental progress of

the civilised world which are being wrought by their practical applications to the cheapening of paper, and to improvements of the automatic printing-press, which, combined with the linking together of all parts of the earth by a network of telegraphic communications, put it in the power of even the poor of the realm to read daily the news of the world, and for a few shillings to provide themselves with a library of classical works. Of scarcely less educational influence upon the public mind are the new methods of photography and mechanical reproduction, by which pictures of current events and the portraits of those who are making contemporary history, and also copies of the world's masterpieces of painting and of sculpture, are widely disseminated with the cheap newspapers and magazines among the mass of the people.

Golden will be the days when, through a reform of our higher education, every man going up to the universities will have been from his earliest years under the stimulating power of a personal training in practical elementary science; all his natural powers being brought to a state of high efficiency, and his mind actively proving all things under the vivifying influence of freedom of opinion. Throughout life he will be on the best terms with nature, living a longer and a fuller life under her protecting care, and through the further disclosures of herself, rising successively to higher levels of being and of knowledge.

The importance to every man of a practical acquaintance with elementary science is obvious. Would it be thought possible that any nation could act so absurdly as to teach its children other languages, and leave them in complete ignorance of the tongue of the land in which they would have to pass their lives? Would it not then be incredible, if it had not become a too familiar fact, that the public schools have, until recently, excluded all teaching of the science of nature from their scheme of studies, though man's relation to nature is more intimate than to his fellow countryman? We live, move, and have our being in nature; we cannot emigrate from it, for we are part of it. Yet our higher education leaves men, who in other directions are well informed, much as deaf-mutes in the presence of nature. They do not hear her most imperative warnings, and can only get on haltingly in their everyday intercourse with the natural forces to which their lives are subjected, by means of the arbitrary signs of empirical custom. The recent introduction of some amount of science-teaching in our higher schools is quite inadequate, alike in kind and in degree. It can be only through a reform of the scheme of their examinations by the universities that we can hope to see science take the equal part with the humanities in general education to which she is entitled.

Two faculties of the mind which it is of the highest importance, especially in early youth, to enlarge and develop by exercise are wonder and imagination. Under the ordinary premature language-teaching of the grammar schools, even the wonder and imagination natural to young minds become so stunted in their growth as to remain more or less dormant throughout life. On the other hand, natural science brings them into full activity and greatly stimulates their development. Nature's fairy tales, as read through the microscope, the telescope, and the spectroscope, or spelt out to us from the blue by waves of ether, are among the most powerful of the exciting causes of wonder in its noblest form; when free from terror it becomes the minister of delight and of mental stimulation.

And surely the master-creations of poetry, music, sculpture, and painting, alike in mystery and grandeur cannot surpass the natural epics and scenes of the heavens above and of the earth beneath, in their power of firing the imagination, which, indeed, has taken its most daring and enduring flights under the earlier and simpler conditions of human life when men lived in closer contact with nature and in greater quiet, free from the deadening rush of modern society. Of supreme value is the exercise of the imagination, that lofty faculty of creating and weaving imagery in the mind, and of giving subjective reality to its own creations, which is the source of the initial impulses to human progress and development, of all inspiration in the arts, and of discovery in science.

Further, elementary science, taught practically with the aid of experiment during a boy's early years, cannot fail to develop the faculty of observation. However keen in vision, the eyes see little without training in observation by the subtle exercise of the mind behind them. From the humblest weed to the stars in their courses, all nature is a great object-lesson for the acquirement of the power of rapid and accurate noting of minute and quickly-changing aspects. Such an early training in the simpler methods of scientific observation confers upon a man for life the possession of an inexhaustible source of interest and delight, and no mean advantage in the keen competitions of the intellectual activities of the present day.

Training in the use of the eyes develops, at the same time, alertness of the intelligence, and suppleness of the mind in dealing with new problems, which, in after life, will be of great value in facing unforeseen difficulties of all kinds, which are constantly arising.

Science, practically taught, does more, for, under the constant control of his inferential conclusions by the unbending facts of direct experiment, the pupil gradually acquires the habit of reasoning correctly from the observations he makes. In particular, he learns the most precious lesson of great caution in forming his opinions, for he finds how often reasoning, which appeared to him to be flawless, was not really so, for it led him to wrong conclusions. Further, from the constant study of nature, the student comes so to look at things as almost unconsciously to discriminate between those which are essential and those which are only accidental, and so, gradually, to acquire the faculty of classing the facts of experience, and of putting them in their proper places in a consistent system or theory. Are there any other studies, it may be asked, by which, in the same time, a young mind could develop an equally enlarged capacity for correct reasoning and acquire so wide an outlook? Yet, notwithstanding the immense intrinsic value of its teaching, science is but one of the studies which are necessary for a wide and liberal education. Intellectual culture, or, in other words, the whole mind working at its best, requires, besides the training of all its powers harmoniously by the study of nature, an acquaintance with many other kinds of knowledge, especially of human history and the development of human thought, and of the human arts. Humanistic studies and experimental science are equally essential, and, indeed, complement each other. Either alone leaves the mind unequally developed, and its whole attitude one-sided, and so produces a narrow type of mind, which is incapable of taking a wide view even of its own side of thought, and has but little sympathy with any subject outside it.

Improved methods of teaching the classical languages, which would permit of the beginning of the study of them at a later age, would leave ample time for an early training in experimental science, which must soon come to be recognised as an essential part of all education.

In future, no grammar or higher school should be considered as properly provided for unless furnished with the necessary apparatus for teaching experimentally the fundamental principles of mechanics, physics, and biology. The pupils should have the use of a small astronomical telescope, and of microscopes for biological work. Such apparatus and instruments can now be purchased at a very small cost.

Clearly, it is only by such a widening of the general education common to all who go up to the universities, before specialisation is allowed, that the present "gap between scientific students careless of literary form, and classical students ignorant of scientific method" can be filled up, and the young men who will in the future take an active part in public affairs, as statesmen and leaders of thought, can be suitably prepared to introduce and encourage in the country that fuller knowledge and appreciation of science which are needed for the complete change of the national attitude on all science questions, which is absolutely necessary if we are to maintain our high position and fulfil our destiny as a great nation.

This address was followed by the award of the medals.

Copley Medal.

The Copley medal is awarded to Prof. Dmitri Ivanovitch Mendeléeff, For.Mem.R.S., for his contributions to chemical and physical science.

Prof. Mendeléeff, born at Tobolsk, in Siberia, in 1834,

stands high among the great philosophical chemists of the last century. As early as 1856 he published his own conclusion that paramagnetic elements have, in general, smaller molecular volumes than diamagnetic elements, and confirmed Avogadro's view that electropositive elements have larger molecular volumes than electronegative ones, both of them results specially interesting in connection with modern views of molecular structure. At that time he had already assimilated and utilised the views of Laurent, Gerhardt, and Williamson on molecular constitution, which made such slow progress in general. Since then, in the words of Dr. Thorpe (NATURE, June 27, 1889), "There is, in fact, no section of chemical science which he has not enriched by his contributions"—mineralogy, chemical geology, organic chemistry, the nature and industrial importance of petroleum, but, above all, physical chemistry and chemical philosophy.

Quoting again from Dr. Thorpe:—"His 'Principles of Chemistry,' published in 1889, and repeatedly reprinted, is a veritable treasure-house of ideas, from which investigators have constantly borrowed suggestions for new lines of research. This book is one of the classics of chemistry; its place in the history of science is as well assured as the ever-memorable work of Dalton." In the course of its preparation he developed the great generalisation known as the periodic law of the elements, with which his name will ever remain most closely associated, especially as a weapon for predicting new elements, and for which he has received the Davy medal of this society, as also have Newlands and Lothar Meyer for their independent advances in the same direction.

This law has changed the face of chemistry by imparting to the study of its numerous independent elements that close inter-connection which is a characteristic of advanced physical theories.

Royal Medals.

A Royal medal is awarded to Prof. John Henry Poynting, F.R.S., on account of his researches in physical science, especially in connection with the law of gravitation and the theories of electrodynamics and radiation.

Prof. Poynting is distinguished both in theoretical and experimental physics. His memoir, *Phil. Trans.*, 1884, "On the Transfer of Energy in the Electromagnetic Field," contains the fundamental proposition which is now universally known as Poynting's theorem. It was followed in *Phil. Trans.*, 1885, by a paper "On the Connection between Electric Current and the Electric and Magnetic Inductions in the Surrounding Field," which works out the current circuit on the supposition of motion of what are now called Faraday tubes. These papers served greatly to elucidate Maxwell's theory, and give a representation of the physical nature of the electric field which is now widely utilised. His long-continued experimental and theoretical researches on the constant of gravitation and on the mean density of the earth are reported in a paper in the *Phil. Trans.*, 1892, and in the Adams prize essay for 1893. Closely related to this subject is an experiment in search of a directive action of one quartz crystal on another, *Phil. Trans.*, 1899, which, though leading to a negative result, is a model of the application of refined methods to a physical research of great delicacy. His recent paper, *Phil. Trans.*, 1903, "On Radiation in the Solar System, its Effect on Temperature, and its Pressure on Small Bodies," is of great interest and significance in cosmical physics. He is the author of various theoretical papers on physicochemical subjects, such as change of state and osmotic pressure, which are conspicuous for originality of conception and clearness of exposition.

The other Royal medal is awarded to Prof. Charles Scott Sherrington, F.R.S., for his work on the central nervous system, especially in relation to reflex action.

Prof. Sherrington has published a series of important papers upon the structure and function of the brain and spinal cord. In the earlier of these he chiefly investigated the course of the several groups of nerve fibres by means of the degeneration method. Passing from the study of structure to that of function, he discovered that removal of the fore brain causes a widespread rigidity of certain muscles, which he called decerebrate rigidity. In the state of decerebrate rigidity, the ordinarily observed reflexes of the body become profoundly altered, and a study of the normal and abnormal reflexes led him to the observation that contraction of one muscle is commonly associated with inhibition of its antagonist. Upon this he formulated the law of the reciprocal action of antagonistic muscles, which is now accepted as of fundamental importance in the coordination of muscular movement. A further study of reflex actions led him to lay down certain general principles with regard to them. One principle deserves especial mention, namely, that hurtful stimuli applied to the skin produce a different form of reflex from that given by stimuli which are not hurtful. This has served as a basis for further investigation on the character of the nerve impulses conveyed by different nerve-endings, on the course taken by the impulses, and on their central connections.

In recent years a considerable amount of work has been done in mapping out the areas of the skin supplied by each of the cranial and spinal nerves. This work, essential both to physiology and to clinical medicine, received its chief impetus and most weighty contribution from the careful and detailed observations of Prof. Sherrington.

The researches of Prof. Sherrington and Dr. Grünbaum, on the localisation of the excitable areas in the cortex of the cerebral hemispheres in the higher apes, have resulted in placing the "motor area" in this animal entirely in front of the central sulcus. The result is now generally accepted as true also for the brain of man—a point of great importance in the surgery of the brain.

Prof. Sherrington's researches have dealt with a number of subjects cognate with that of the central nervous system. He has shed light on questions connected with the afferent nerves of skeletal muscle, the efferent nerves of the arrectores pilorum and of the cranial blood-vessels, the innervation of various viscera, the trophic centre of the fibres of the roots of the spinal nerves, the knee jerk, and with the physiology of vision.

Davy Medal.

The Davy medal is awarded to Prof. Albert Ladenburg, on account of his researches in organic chemistry, especially in connection with the synthesis of natural alkaloids.

Thirty years ago, when the validity of Kekulé's famous formula for benzene was the subject of much discussion, Ladenburg was the first to prove, by laborious research, the important proposition that the six hydrogen atoms in the hydrocarbon are similarly situated and discharge the same functions, and hence that three, and only three, *di*-substitution derivatives can exist.

He has also devoted many years to the study of the natural alkaloids. This pioneer work, attended by many experimental difficulties, was rewarded by success in the synthesis, for the first time in 1886, of an optically active compound identical with the alkaloid coniine existing in the hemlock plant. Since that time he has largely added to our knowledge of the chemistry of hyoscyamine, atropine, and other alkaloids of the mydriatic class.

Hughes Medal.

The Hughes medal is awarded to Prof. Augusto Righi, for his experimental researches in electrical science, including electric vibrations.

Prof. Righi has been for many years a prominent and active worker in the sciences of light, electricity, and magnetism.

Among the subjects which have engaged his attention are the Hall effect, and the change of electric conductivity of bismuth in a magnetic field. At an early period he carried out an elaborate investigation on the reflection of light at the surface of a magnetised body, repeating and extending Kerr's observations with more powerful apparatus; in particular, he showed how the amount of the rotation of the plane of polarisation depends upon the wave-length of the light.

A valuable series of papers related to phenomena produced by the ultra-violet rays, including the first discovery of the discharge of negative electricity from a freshly polished zinc surface under their influence. He has also investigated the potential in the neighbourhood of the kathode in a Crookes's tube, and made many experiments on the spark discharge in gases and the action of the Röntgen rays.

His work on electric radiation has been collected in a book, "L'Ottica delle oscillazioni elettriche," Bologna, 1897. He rendered fundamental service to exact experiment on this subject by simplifying the practical conditions of the problem; and he applied his improved apparatus to numerous investigations on the behaviour of electromagnetic waves, of short and therefore manageable wavelength, under very varied conditions, on their absorption, polarisation, reflection and refraction, and on the behaviour of dielectrics in the field of radiation. This work entitles him to a high place among those who developed the lines of experimental investigation opened up by the great discoveries of Hertz.

More recently he has contributed substantially to the study of the phenomena of radio-activity and the related ionisations.

THE DEATH-KNELL OF THE ATOM.[1]

Old Time is a-flying; the atoms are dying;
Come, list to their parting oration:—
"We'll soon disappear to a heavenly sphere
On account of our disintegration.

"Our action's spontaneous in atoms uranious
Or radious, actinious or thorious:
But for others, the gleam of a heaven-sent beam
Must encourage their efforts laborious.

"For many a day we've been slipping away
While the savants still dozed in their slumbers;
Till at last came a man with gold-leaf and tin can
And detected our infinite numbers."

Thus the atoms in turn, we now clearly discern,
Fly to bits with the utmost facility;
They wend on their way, and in splitting, display
An absolute lack of stability.

'Tis clear they should halt on the grave of old Dalton
On their path to celestial spheres;
And a few thousand million—let's say a quadrillion—
Should bedew it with reverent tears.

There's nothing facetious in the way that Lucretius
Imagined the Chaos to quiver;
And electrons to blunder, together, asunder,
In building up atoms for ever!

W. R.

NOTES.

THE Hayden memorial gold medal has been awarded by the Academy of Natural Sciences of Philadelphia to Mr. C. D. Walcott, director of the U.S. Geological Survey, in recognition of the value of his individual contributions to geological science.

THE University of Basle, to which the late Prof. Dr. Georg W. A. Kahlbaum was attached for nearly twenty years, has received the sum of 100,000 francs from the mother of the deceased professor. Further, Prof. Kahlbaum's scientific library and physical instruments are also to be handed to the university.

FROM Berlin we learn, according to the *Chemiker-Zeitung*, that the German State grant for the support of scientific, technical, and similar undertakings is to be increased by 115,000 marks. The sum of 179,500 marks is to be spent upon increasing the accommodation for the permanent exhibition devoted to the interests of the working classes; 120,000 marks to be a first instalment for an investigation of sleeping sickness; 30,000 marks to be devoted to the development of the *Starkstrom*-laboratory of the Reichsanstalt; 43,850 marks to be contributed to the kite station on Lake Constance for experimental investigations of the higher air strata.

THE annual conference of the Pharmaceutical Society will be held in Birmingham in the week beginning July 23, 1906.

FOR the erection of a monument to Franz Reuleaux in the Charlottenburg Technical School, an appeal for subscriptions has been issued by the engineering department of the school.

MR. F. W. DYSON, F.R.S., chief assistant, Royal Observatory, Greenwich, has been appointed Astronomer Royal for Scotland, and also professor of practical astronomy, Edinburgh University, in succession to the late Dr. Copeland.

AN exhibition of electrical, optical, and other physical apparatus has been arranged by the Physical Society, and will be held on Friday evening, December 15, at the Royal College of Science, South Kensington. Admission will be by ticket only.

IT is reported, *Science* says, that the Mexican Astronomical Society has awarded the prize offered by the Bishop of Leon for some notable astronomical discovery to Prof. W. H. Pickering, of Harvard College Observatory, for the discovery of the tenth satellite of Saturn.

AN archæological museum, which will devote special attention to Indo-Chinese matters, has been established by the French Government at Pnompenh. The museum will be under the scientific control of the École française d'Extrême-Orient, the chief of the archæological department of which school will act as director of the new museum.

A DESCRIPTION is given in the *Engineer* of December 1 of some interesting machine-tools, formerly the property of James Nasmyth, lately placed on view in the southern galleries of the Victoria and Albert Museum. Although associated primarily with the invention of the steam-hammer, James Nasmyth did valuable work in the improvement of machine-tools.

AN extensive landslip has occurred in the Danish island of Möen, destroying part of the beautiful scenery along Lille Klint. From the beach, steep slopes of Boulder-clay, thickly wooded, rise about 250 feet. The right bank of the valley from Liselund Chateau, and the coast-cliff for some 400 yards to the south of it, in all some fifteen or twenty acres of woodland, are described as having sunk bodily. The sea had been encroaching, but underground water is regarded as the cause.

A *Times* correspondent reports that a local Greek newspaper publishes details of the earthquake of November 8, which caused great damage to the various monasteries on Mount Athos. The shocks, which were extremely violent, occurred in the night. None of the monasteries escaped without serious injury. The shocks were not confined to the colony of monks. At Caryes the post-office, the police station, and other public buildings have been ruined, and at Cassandra, Jerissos, Gomate, and other villages within the districts affected the churches and many houses have been destroyed.

IN the course of a lecture delivered at the Armstrong College, Newcastle-on-Tyne, on December 2, the Hon. C. A. Parsons, F.R.S., dealt with the application of turbines to Atlantic passenger steamers, and described the

[1] Sung at the Chemical Laboratory dinner at University College, November 17.

recent trials of the Cunarder *Carmania* with turbine engines, and her sister ship, *Caronia*, with reciprocating engines, the latter being one of the most economical vessels ever built. The *Carmania* beat the *Caronia* by one knot, and was at least 16 per cent. more economical than her sister vessel driven by reciprocating engines. The *Carmania* is the first example on so large a scale, and it may be reasonably expected that improvements in detail will increase still further the excellent results she realised.

MAJOR MOODIE, Governor of Hudson Bay, has received a communication, dated May 22 last, from Captain R. Amundsen's Norwegian Expedition to the North Pole. The *Gjoa*, with the expedition on board, spent last winter in Simpson Strait, King William's Land, 400 miles north of Fullerton. Captain Amundsen dispatched letters from Fullerton in November, 1904, reporting the expedition well, but short of dogs. The messenger reached Governor Moodie's headquarters on March 18 of this year, and on March 26 he started back with ten dogs. The messenger reached Captain Amundsen's party on May 22, and then returned to Fullerton with a second letter. This reported that the observations of the party had been conducted undisturbed since the establishment of the magnetic station in October, 1903.

AT a meeting of the council of the Invalid Children's Aid Association, held last week, Sir William Broadbent delivered an address on the tuberculous children of the metropolis, in which he pointed out that while consumption, the most prevalent form of tuberculous disease, has steadily diminished year by year for the last thirty years, there has been no corresponding diminution in the death-rate of tuberculous affections specially incident to infancy and early childhood. He strongly urged the establishment of country and sea-side homes where delicate children in the pre-tuberculous stage, or those actually suffering from tuberculosis, could receive the benefits of the open-air treatment. After alluding to the sanitary defects of tenements in which the poor too often have to live, he pointed out that the greatest safeguard against tuberculosis in early life, and against infantile mortality generally, is that the child should be suckled by the mother.

THE council of the Iron and Steel Institute has arranged that the annual general meeting of the institute shall be held in London on May 10–11, 1906. In place of the usual autumn meeting, a joint meeting with the American Institute of Mining Engineers will be held in London on July 23–28. It is intended during the week following to give the American visitors an opportunity of seeing some of the iron-making districts. It is anticipated that the visiting party will include many of the leading ironmasters who entertained the Iron and Steel Institute in America in 1890 and 1904. The Lord Mayor of London has consented to act as chairman of the London reception committee, and to give an evening reception at the Mansion House.

LECTURES on agricultural subjects are given in connection with the County Technical Laboratories, Chelmsford, on Friday afternoons, which is the market day of the town. The lectures last about half an hour, and are intended for farmers and others interested in agriculture. A discussion follows the lecture. The subjects for the December meetings, with the lecturers dealing with them, are as follows:—The field culture of the potato, by Mr. A. Steel; England as a producer of sugar from home-grown sugar beetroot, by Mr. Sigmund Stein; some agricultural facts and figures, by Mr. R. H. Rew. This excellent plan of making it easy for farmers to hear of the results of modern agricultural research deserves to be successful, and could be adopted with advantage in other agricultural centres.

AT a general monthly meeting of the members of the Royal Institution, held on Monday, special thanks were returned to Dr. Ludwig Mond, F.R.S., for his donation of 500*l.* to the fund for the promotion of experimental research at low temperatures. It was announced that the managers had elected Prof. W. Stirling Fullerian professor of physiology. The following are among the lecture arrangements at the Royal Institution before Easter:—A Christmas course of six illustrated lectures, adapted to a juvenile auditory, by Prof. H. H. Turner, on astronomy; Prof. E. H. Parker, three lectures on impressions of travel in China and the Far East; Prof. William Stirling, six lectures on a physiological subject; Dr. J. E. Marr, three lectures on the influence of geology on scenery (the Tyndall lectures); Mr. Benjamin Kidd, two lectures on the significance of the future in the theory of evolution; Mr. Francis Darwin, three lectures on the physiology of plants; Prof. B. Hopkinson, three lectures on internal combustion engines; Mr. J. W. Gordon, two lectures on advances in microscopy; and Prof. J. J. Thomson, six lectures on the corpuscular theory of matter. The Friday evening meetings will commence on January 19, when Prof. J. J. Thomson will deliver a discourse on some applications of the theory of electric discharge to spectroscopy. Succeeding discourses will probably be given by Prof. S. P. Thompson, Mr. H. F. Newall, Mr. W. C. D. Whetham, Dr. R. Caton, Dr. Hutchison, Sir Andrew Noble, Bart., Prof. P. Zeemann, Mr. W. B. Hardy, and others.

THE Russian physiologist, Prof. Iwan Michaelowitsch Ssetschenoff, emeritus professor of the University of Moscow, who died on November 15, was born in 1829. He first attended an engineering school in St. Petersburg, but subsequently took up medicine, and, after passing his final examination in Moscow in 1856, studied for some time in Germany. By his interesting paper on brain reflex he first attracted the serious attention of his colleagues of the Medico-chirurgical Academy in St. Petersburg, in which he was appointed an assistant professor of physiology in 1860, but on account of the strict censure to which his further work was submitted, Ssetschenoff published the results of his scientific investigations in Germany. A pupil of Du Bois-Reymond, Helmholtz, Hoppe-Seyler, and Ludwig, he always remained in direct connection with European scientific circles. The greatest services which Ssetschenoff rendered to science lie in the province of physiological chemistry, as, for instance, his works on the absorption of carbon dioxide by the blood. A complete list of his numerous researches would clearly testify to his many-sidedness and breadth of view. Moreover, he earnestly endeavoured to popularise his special science to the Russian mind by presenting it in an easily intelligible form in such well written and well reviewed works as his "Physiological Studies," "Physiology of the Vegetable Processes," "Psychological Studies," &c. In 1870 Ssetschenoff was appointed professor of physiology in the University of Odessa, and in 1876 to a similar post in St. Petersburg, which he held until 1889. He then went to Moscow, where he first acted as privatdocent and afterwards (1891) as professor, retiring in 1896.

IN the second part of his article on the histology of cartilage and kindred tissues, published in vol. lxxx., part ii., of the *Zeitschrift für wissenschaftliche Zoologie*, Mr. J. Schaffer discusses these structures in the hag-fish (Myxine), with special reference to the cranial skeleton of that genus, adding an appendix on the cartilage of the

lampreys. The organisation of the "bear-animalcules," or Tardigrada, those microscopic creatures found in damp moss and the gutters of roofs, forms the subject of an article by Mr. A. Basse; while the third and last communication is the first portion of a memoir by Mr. S. Hlava on the Radiata, the author dealing in this instance with the anatomy of *Conochiloides natans*.

In an important article on the cranial nerve-components of the lamprey (Petromyzon), published in Gegenbaur's *Morphologisches Jahrbuch*, vol. xxxiv., part ii., Mr. J. B. Johnston shows that the general arrangement is similar to what obtains in fishes, although with certain markedly primitive features. As the result of a study of the visual organs of the ascidians of the Salpa group, Mr. W. Redikorzen arrives at the conclusion that the primitive chordates possessed a series of paired organs of this nature extending from the head to the tail—one pair to each body-segment. Moreover, the pineal eye was certainly in the first instance a dual structure, but later its two elements coalesced and subsequently degenerated. This segmental ocular type has entirely disappeared from vertebrates, and is now represented only by traces among the lower groups. The other papers in the same issue include one by Mr. T. Mollison on the dorsal gland of Dendrohyrax, and a second by Mr. J. Böhm on the reproductive organs of the sheep.

In the November issue of the *Zoologist* Mr. G. Renshaw resumes his interesting series of "obituaries" of exterminated animals, dealing in this instance with the Réunion starling, the sole representative of the genus Fregilupus. Easily recognised by its parti-coloured plumage and long crest, this bird was probably discovered by Flacourt in the middle of the seventeenth century. In the early part of the last century it was abundant, but in 1833 had become extremely scarce, and by about 1860 had probably ceased to exist even in its last refuge in the interior of the island. Twenty-one skins, of which one is in the Natural History Museum (although not shown to the public), and two skeletons, of which one is at Cambridge, are all the relics of this interesting species Mr. Renshaw can identify. In another paper Dr. J. Murie discusses the flying-fish captured in September last in a back-water connected with the Medway estuary. It is believed to belong to *Exocoetus lineatus*, a species not previously recorded as an occasional straggler into British waters.

The almost complete shell of a large Cretaceous turtle from Kansas has afforded Mr. G. R. Wieland the opportunity of enlarging our knowledge of the extinct genus Toxochelys, his communication on the subject being published in the November issue of the *American Journal of* Science. The structure of the shell agrees with that of certain extinct representatives of the Chelonidæ (Lytoloma), but the skull approximates to that of the Chelydridæ. That the genus should be classed with the true turtles the author is convinced, although he believes the limbs to have been independently modified for swimming. The most interesting part of the paper relates, however, to certain bony elements overlying the junctions between the neural bones of the carapace, and it is suggested that these, which may have been more extended in other types, may represent the mosaic-like shell of the leathery turtles (Dermochelyidæ). If this suggestion be well founded, the puzzle of the origin of the carapace of Dermochelys will be practically solved.

The *Comptes rendus* of the zoological congress held at Berne last year contains the full report of a series of experiments undertaken by Mr. H. Piéron with the view of ascertaining the seat of the recognition-sense among ants. The theory of a "language-sense" resident in the antennæ is rejected by the author, to some extent on the ground that these organs are employed in feeling objects of every kind, animate and inanimate. On the other hand, it is inferred that these organs are endowed with an olfactory sense, on which depends mutual recognition among ants. As is well known, ants not only of different species, but of different communities of the same species, display marked hostility to one another. By making an infusion of ants of one particular community, and anointing the neuters of another community with this infusion, it was found that in most instances the hostile ants thus treated were not attacked by the members of the community from which the infusion was made, this immunity from attack lasting only so long as the influence of the infusion persisted. On this and other experiments of a kindred nature the author's conclusions are mainly based. But to connect these experiments with the antennæ, an ant was deprived of those appendages, when it was found to attack friends and foes alike. Mr. Piéron has also favoured us with a copy of another paper, from the *Bulletin de l'Institut psychologique* for 1904, on the *rôle* of the muscular sense in determining orientation among ants.

The experimental station at Peradeniya, Ceylon, has rapidly grown into public favour, and large numbers of agriculturists visit the station to get practical lessons in their craft. From the annual report of the controller, Mr. H. Wright, published as vol. iii., No. 10, of the Circulars of the Royal Botanic Gardens, it will be seen that a considerable amount of time has been devoted to the subject of green manures. While the first object consists in growing a crop to turn into the soil, the additional advantage possessed by leguminous plants of fixing free nitrogen has led to their almost exclusive use. In a tropical country green manures also prevent erosion of the soil by heavy rain and the baking of the surface by the hot sun. *Crotalaria striata* is strongly recommended for tea estates, since it produces a heavy crop. A plant of a different kind is the thornless dadaps, *Erythrina lithosperma*, from which cuttings five feet long planted in the rainy season gave a substantial yield. The Pondicherry variety of groundnut has also proved useful.

In the report of the director of the Mineralogical Survey contained in the Ceylon Administration Reports much valuable information is given by Mr. A. K. Coomaraswamy and Mr. James Parsons regarding the occurrence of corundum, of minerals containing rare earths, of precious stones, of crystalline limestone, of mica, and of graphite. With the aid of numerous illustrations, interesting descriptions are also given of the native Sinhalese manufacture of iron and steel, and of the washing of gem-bearing gravels. The minerals containing rare earths have been derived from intrusive granite rocks. Thorianite containing more than 70 per cent. of thoria and 12 per cent. to 15 per cent. of uranium oxide occurs in moderate quantities near Kondrugala. The whole amount obtained hitherto is less than 30 cwt., and it is doubtful whether any very extensive deposit occurs. Thorite, allanite, and minerals of the samarskite group have also been found. The gems met with are transparent and well coloured varieties of corundum, spinel, zircon, tourmaline, topaz, garnet, chrysoberyl, cordierite, amethyst, felspar, and beryl. Many of these are exhibited in the mineral gallery of the museum attached to the survey, and the director is making strenuous endeavours to get together a thoroughly representative collection which can always be consulted by visitors to Ceylon.

A USEFUL series of memoirs is being published monthly in the *Bulletin du Musée océanographique de Monaco*. In No. 44, for October, Prof. Hergesell discusses some future problems of maritime meteorology; by this name he refers to the meteorological phenomena of the atmosphere over the oceans. He remarks that if our knowledge is well advanced over the land, it is much less so over the oceans, and that our knowledge over the sea is due to a great extent to such expeditions as those of the *Challenger*, *Gazelle*, and *Valdivia*. Others might have been cited, *e.g.* the Austrian expedition of the *Novara* in 1857–9. But we cannot help remarking that the meteorology over the oceans might be considered as fairly well defined, owing to the labours during the last fifty years of such men as Maury in the United States, FitzRoy and Toynbee in this country, Leverrier and Brault in France, Buys Ballot and Andrau in Holland, Neumayer in Germany, and, of course, including their successors in the central meteorological offices of the respective countries. But while much has been done in the investigation of the upper air over the land by the use of kites and balloons, both manned and unmanned (or "sounding" balloons), and some surprising results have been obtained, little has yet been done in this respect over the oceans. The balloon ascents over the land have shown, for instance, that there is a warm stratum of air at a height of about 11 kilometres; that the decrease of temperature with altitude ceases more or less abruptly, and that the temperature actually increases for a further height of several kilometres. This zone of inversion is probably intimately connected with the general circulation of the atmosphere, and it is most important to know the exact conditions over the ocean, especially in equatorial and certain other localities. We are glad to see that the Prince of Monaco has succeeded in interesting the Emperor of Germany in these questions, and that the cooperation of the German Navy in elucidating them appears to be assured.

OF the papers read at the optical convention in June last, a number of those having a special bearing on the microscope are abstracted in the *Journal of the Royal Microscopical Society* for October. In one of these papers, dealing with equivalent planes of optical instruments, Mr. Conrad Beck gives a simple explanation of the why and wherefore of the particular arrangement of lenses adopted in the compound microscope. A high-power microscope may have an equivalent focal length of only a few thousandths of an inch, but the plan of using lenses separated by large intervals gives an instrument in which the equivalent planes (*i.e.* the principal planes) are outside the system of lenses, thus allowing sufficient working distance between the front lens and the object.

IN connection with Prof. Paul Harzer's recent communication to the British Association (*vide* NATURE, October 26), we read with considerable interest an address delivered by him at the University of Kiel on the Emperor's last birthday, published by Lipsius and Tischer, of Kiel, dealing with the development of exact sciences in ancient Japan. In the Imperial Library of Tokyo there are no less than 2000 written and printed Japanese mathematical works extending back to the year 1595; and it is scarcely remarkable that the determination of the "Ludolphian Number" (Pi) played a prominent part in the thoughts of early Japanese mathematicians. In 1627 the approximation 79/25 was known, while in the second half of the seventeenth century values had been obtained which are correct to 9 or 10 places. The well known value 355/113 was known in 1709, and in 1722 and 1739 values correct to 49 and 51 places had been found. Among the early "circle squarers" Kowa Seki (1642–1708) occupied a leading place. His methods, which were applicable to circular arcs generally, depended on successive bisection, but in solving the quadratic equations by means of series the binomial expansion of the square root was used. During the eighteenth century four series for Pi were known to Naomaro Ajima, who also dealt with the ellipse. At the beginning of the nineteenth century Enzo Wada was acquainted with the catenary and cycloid, and it now appears proved that Seki and his immediate successors studied the binomial theorem, theory of numbers, the properties of maxima and minima, determinants, and spherical trigonometry. Of geodetical observations we have records dating from 1613, and these culminated in the measurements of arcs of the meridian by Ino Chukei (?) in 1800–1818. On the other hand, even as late as 1895, Prof. Harzer finds complaints of the neglect of higher mathematical study in Japan. The question as to how far the ideas of the early Japanese mathematicians were imported from the west through the medium of the Dutch trading ships or other means occupies a prominent part in Prof. Harzer's dissertation.

THE twenty-fifth number (n.s.) of the *Transactions of the Oxford University Junior Scientific Club* contains, in addition to a list of the officers and new members and balance sheet, a paper by Mr. A. F. Walden on some recent views on the constitution of inorganic compounds, which gives an account of Werner's ideas as to the nature of complex cobalt and chromium salts. Mr. A. S. MacNalty deals with trypanosomiasis and sleeping sickness.

IN No. 18 of the *Revue générale des Sciences* M. Bernard Brunhes, director of the Observatory of Puy-de-Dôme, gives an interesting account of recent work on terrestrial magnetism in central France. Notice is taken of the anomalies met with by workers in other countries, and particular emphasis is laid on the tendency of magnetic rocks to produce these effects. The Puy-de-Dôme affords an especially good example of the influence of magnetic rocks on the terrestrial magnetism of a district. A description is given of the method adopted in measuring the declination and inclination due to the permanent magnetisation of the specimens of rock selected for experiment.

THE delegates of the Clarendon Press, Oxford, have published in pamphlet form, at sixpence net, an addendum to Mr. J. Cook Wilson's "On the Traversing of Geometrical Figures," which was reviewed in the supplement to our issue of October 19 (p. vi).

WE have received from Messrs. A. Gallenkamp and Co., Ltd., of Sun Street, Finsbury Square, London, a copy of the fifth edition of their general chemical and scientific apparatus catalogue, which has been arranged to meet the requirements of the session 1905–6. The catalogue runs to 534 pages, and is profusely illustrated with clear and helpful illustrations. The arrangement of prices and details of sizes and similar facts in a simple tabular form throughout, and the concisely expressed descriptions of the forms of apparatus available, reduce the trouble of reference to a minimum. There is a good index provided also. Special attention may be directed to the section giving particulars of many forms of electrochemical apparatus, which should prove of interest to teachers and students of electrochemistry. The catalogue is worth examination by teachers who have charge of chemical and physical laboratories, and also by men of science engaged in research work. The excellence of this and other similar catalogues which have come before us recently is instructive evidence of the progress which has been made in the teaching of science in our schools and colleges.

OUR ASTRONOMICAL COLUMN.

COMET 1905*b*.—Further observations of this comet are recorded in No. 4056 of the *Astronomische Nachrichten*. As an error was made in the Bamberg record of R.A. on November 18, it became necessary for Herr Ebell to recalculate his elements and ephemeris, and the amended results are contained in Circular No. 81 from the Kiel Centralstelle. The corrected elements are as follows:—

T = 1905 October 25·7163 (Berlin).

$$\left.\begin{array}{l} \infty = 132\ 34'9 \\ \Omega = 222\ 55'0 \\ i = 140\ 37'1 \end{array}\right\} 1905{\cdot}0$$

$$\log q = 0{\cdot}02188$$

The new ephemeris gives the position of the comet, at 12h. M.T. Berlin, on December 10 as $\alpha = 23$h. 30m. 53s., $\delta = -7^\circ\ 24'{\cdot}1$, but, as its brightness at that time will be only 0·07 of its brightness when discovered (mag. 7·5), the object will be a very difficult one to observe.

THE ANOMALOUS TAILS OF COMETS.—In No. 4, vol. xxii., of the *Astrophysical Journal* Prof. Barnard discusses the anomalous forms presented by the tails of comets. The generally accepted idea is that the tails are produced by the sun's repulsive force acting on the cometary matter, but, from a study of a number of photographs—more especially of Brooks's (1893) comet—Prof. Barnard has arrived at the conclusion that too much importance is attached to this cause, and that the eruptive action of the comet itself, and the active interference of external matter, should also be included amongst the tail-producing causes. Short, straight, minor tails, issuing from the nucleus at considerable angles to the main tail, seem to corroborate the existence of the comet's own eruptive force, or, at least, of some force in addition to that supplied by the sun.

The rapid deflections and distortions of the tail or tails, as in Brooks's comet, suggest the existence of some resisting medium which is not evenly distributed throughout interplanetary space, and such a medium would also explain the anomalous brightening up of some comets (*e.g.* Sawerthal's, May, 1888) and the disruption of such a comet as Biela's.

Finally, Prof. Barnard suggests that all bright comets possessing tails should be photographed hour by hour, as the day by day photographs hitherto obtained are separated by intervals so long that the changes recorded are not necessarily connected.

NOVA AQUILÆ NO. 2.—A number of photographs of the region about Nova Aquilæ, taken with the Bruce telescope, and with the 24-inch reflector of the Yerkes Observatory, are discussed by Mr. J. A. Parkhurst in the November *Astrophysical Journal*. These show that in the spring and summer of 1904 the Nova was at least fainter than the fifteenth magnitude.

The final mean value obtained for the position of the Nova for 1900 was

R.A. = 18h. 56m. 48·96s., dec. = $-4^\circ\ 35'\ 20''{\cdot}3$,

and a comparison of the images on different plates showed that the Nova was only slightly coloured.

A reproduction of one of the photographs taken with the 24-inch reflector (exposure, three hours) shows that the Nova is situated in a dark lane, almost devoid of stars, in a very rich field in the Milky Way, and also illustrates, in a very striking manner, the connection of Novæ with the galaxy.

CATALOGUE OF BINARY STAR ORBITS.—The results of a critical study of all published double-star orbits are published in Bulletin No. 84 of the Lick Observatory by Prof. R. G. Aitken.

The catalogue is divided into two lists, of which the first, relating to fifty-three stars, contains the elements of those orbits which Prof. Aitken considers to be fairly trustworthy. The second contains the names, the period, and the name of the computer of ninety-one stars of which Prof. Aitken considers the published orbits are too untrustworthy to be of any practical value.

A number of critical and explanatory notes relating to some of the individual stars accompany Prof. Aitken's catalogue.

INDIAN METEOROLOGY, 1892–1902.[1]

SIR JOHN ELIOT, in discussing recent meteorological phenomena, says:—"The period 1892–1902 was unique in the meteorology of India for the magnitude and persistence of the variations of rainfall, cloud, humidity and temperature from the normal."

This period can be divided into two parts, abnormal in opposite directions:—1892–4 characterised by excess of rain, cloud and humidity, and a reduced temperature, and 1895–1902 characterised by deficient rainfall, less cloud, drier air, and an average temperature above the normal.

The normal rainfall for three years (taking the average of 450 selected stations) is 123 inches, while the total rainfall for the period 1892–4 was 143·5 inches, an excess of 20·5 inches. The actual rainfall for the eight years 1895–1902 was 303·8 inches against the normal 328·7 inches, a deficiency of 24·9 inches.

During two years of this dry period the deficiency was so great over certain areas as to cause very severe droughts, which in turn caused famines. These two famines were, both in affected area and affected population, the worst during the last 150 years. The drought of 1896 and the famine of 1897 afflicted the United Provinces, Central Provinces, Central India, and Rajputana, an area of 300,000 to 400,000 square miles, 3,000,000 persons receiving relief. The drought of 1899 and the famine of 1900 affected South Punjab, Rajputana, Central India, Berar, Central Provinces, Hyderabad, Bombay Presidency and part of Orissa, Chota Nagpur, and Madras, an area of 600,000 to 700,000 square miles, and 6,500,000 persons required relief.

In discussing the meteorology of so large an area as India, it is impossible to detail all the local variations, but from among some examples given, Kilba, a station in the Simla district, may be mentioned. During the eleven years under discussion, Kilba for ten years received deficient rainfall, and instead of the normal 441·9 inches received 304·4 inches, the deficiency being equal to 3½ years' normal fall.

Using the data from 450 stations selected by the late Mr. Blandford as most trustworthy and representative, and giving due weight according to the area represented by each station, the average rainfall over India is given in inches:—1892, 46·18; 1893, 50·16; 1894, 47·56; 1895, 38·90; 1896, 36·26; 1897, 40·94; 1898, 41·52; 1899, 29·85; 1900, 40·52; 1901, 36·86; 1902, 39·04, the normal annual rainfall being 41·09 inches. The division of these years into a wet and a dry season is obvious.

On examining the amount of rainfall during the different seasons of the year, the fact is brought out clearly that all the seasons were affected by the abnormal conditions. During 1892–1894 all parts of the year had a tendency to excess rain. In 1893 the dry season had relatively more excess rain than the wet season. During the dry period 1895–1902 there was a tendency to deficiency of rain during all the seasons. Yet during a normal year the meteorological conditions which obtain during the wet season and the dry season are quite inverse of each other.

The persistence of the abnormalities through the seasons is also shown by the observations of cloud amount, humidity and temperature.

Discussing the geographical distribution of the rain, Sir John Eliot points out that during the wet period 1892–4 all parts of India received excess rain except in 1894, when the Bombay and Malabar district and the Madras district were deficient by 2 per cent. and 3 per cent. of the normal respectively. In 1892 the excess was more marked in those areas which received their south-west monsoon rain by the Bombay or Arabian Sea current, in 1893 and 1894 in those areas supplied by the Bay of Bengal current, and the excess was relatively greater in those areas which are near the interior limits of the fields of the two currents. The abnormal extension and strength of the monsoon currents are indicated by this excess in the interior.

During the period there was generally excess rain in

[1] "A Preliminary Investigation of the more Important Features of the Meteorology of Southern Asia, the Indian Ocean, and Neighbouring Countries during the Period 1892–1902." With Appendices. By Sir John Eliot, M.A., F.R.S., K.C.I.E. (Indian Meteorological Memoirs, vol. xvi. part ii.).

Baluchistan, Afghanistan, Persia, Zanzibar, and Mauritius, while the rainfall of Arabia, the Straits Settlements, and Port Blair was generally in defect. The defect at Port Blair is an illustration of the general rule that the rainfall of the Indian Sea area frequently varies inversely with that of the land area.

During the dry period 1895–1902 there was an almost continuous deficiency of rain over North Bombay, Central Provinces, Central India, and the Punjab. There was deficient rainfall for five years in Bengal, for four years in United Provinces and Madras, and for seven years in east and south Punjab. The interior districts suffered more than the coast, and those supplied by the Bombay current more than those supplied by the Bengal current. In 1899 the rainfall of North Bombay was 48 per cent. below the normal, and that of Rajputana and Central India 31 per cent. below. For five years out of eight these areas received at least 20 per cent. less rain than the normal.

The countries bordering on Indian area, and including Australia and South Africa, mostly suffered from want of rain.

During the wet period 1892–4 the monsoons were remarkable for the length of time over which they extended and for the persistence and steadiness of the monsoon conditions. In the dry period 1895–1902 the monsoons were generally characterised by their shortness. In 1896 and 1899, the years of drought, there was no prolonged delay in the commencement of the monsoon rains, but they stopped earlier than usual by three to seven weeks in the case of the Bombay current, and two to six weeks in the case of the Bengal current. This abrupt termination of the rains had a most disastrous effect upon the crops, especially in the Gangetic Plain and the Central Provinces. The crops dried and withered, and famine resulted.

The drought of 1896 was due in the United Provinces to scanty rainfall throughout the whole season, whereas in the Central Provinces and Berar it was due to the early termination of the rains. The year 1899 was characterised by the lack of heavy falls (*i.e.* falls of more than 3 inches in twenty-four hours) over all India, and especially so in the field of the Bombay current.

The data available show that the rainfall for all the countries which depend for their rain on the Indian Ocean was in excess during 1892–4, and in defect during 1895–1902. The rainfall over Russia, Turkestan, and Central Asia varied from the normal in the opposite manner.

The observations of cloud amount, relative and absolute humidity and temperature, show that the curves for these meteorological elements agree very closely with the curve for rainfall.

In discussing the variations of atmospheric pressure, Sir John Eliot refers to the important fact that the long-period variations as disclosed by barometric observations are similar in direction, amount and epoch over the whole of India, and gives both annual and monthly data showing this. Examination of the data giving the monthly variation of pressure from the normal shows that there were fairly long periods of continued excess or defect of pressure, that there was a decided oscillation of pressure. The period of oscillation is given as about two years. Sir Norman Lockyer and Dr. Lockyer, in a recent paper dealing with the rainfall of the Thames basin, refer to the annual pressure variation at Bombay, and speak of a 3·8-year period. Sir John Eliot gives a table showing the approximate dates of the changes from excess pressure and *vice versâ*, and notes that these changes almost invariably occur about the time of the change of season.

If these oscillations were due to exchange of air between the Indian Ocean and southern Asia, such as might accompany the seasonal changes, then the oscillations of pressure over these areas would be of similar period, but of opposite phase; but comparison of the Indian data with data from East Indies, China, South Africa, and Australia shows that this was not generally the case during 1895–1902. In 1893, when there was a deficiency of pressure recorded at Batavia, Singapore, Cape Town, Perth, and Adelaide, there was excess of pressure at Mauritius, Zanzibar, Hong Kong, and Zika Wei, and over India, but in other years, notably 1896, 1898, and 1899, there was a general agreement over the whole Indian Oceanic area and southern Asia. According to Sir John Eliot, this was not the case previous to the period under discussion. He says (p. 273):—"It was shown in the memoir[1] that the pressure variation at Mauritius from 1877 to 1889 presented long period oscillations or variations of similar period but opposite phases to the pressure variations in India," and also (p. 276) "the usual relation based upon previous investigations is for the pressure variations in Southern Asia to be of opposite character or sign to those of the Indian Oceanic region." Therefore he concludes that there was some great and abnormal movement of air affecting the barometric pressure over half the eastern hemisphere, but he has no data available to show the region where the opposite variation has taken place.

Sir Norman Lockyer and Dr. Lockyer, in their paper[2] on "The Similarity of the Short Period Pressure Variations over Large Areas," refer to a set of curves representing the pressure variations in Bombay, Colombo, Batavia, Mauritius, Perth, Adelaide, and Sydney, saying "the striking similarity between these curves shows that over the whole of this area, which includes both north and south latitudes, the same kind of variations is in action, and that therefore the whole region is intimately connected meteorologically."

These curves refer to the period 1874 to 1901. Attention might be directed to the fact that the term "long-period" seems to be applied by Sir John Eliot to variations which, when discussed by Sir Norman Lockyer, are called "short-period."

In another paper[3] by Sir Norman Lockyer and Dr. Lockyer two pressure curves are given, one for Bombay and one for Cordoba (Argentine), which are referred to thus:—"Dealing with the pressure of Cordoba during the high pressure months April to September, the curve representing the variation from the mean from year to year is exactly the inverse of the curve representing the Bombay and other Indian pressures for the same months over the same period of time. The cause therefore which raises the mean value for the low pressure months over the Indian area would appear to lower the mean value of high pressure months at Cordoba simultaneously. In fact we have a see-saw."

In a further paper[4] by the same authors, the surface of the globe is divided into two areas, one having the pressure variations of the Indian type and the other those of the Cordoba type.

These quotations show that there is evidently a difference of opinion on the question of the similarity or dissimilarity of the pressure conditions of Southern Asia, Australia, and Africa previous to the year 1892; and it is quite possible that the meteorology of these regions during the period, 1892–1902, was not so abnormal as Sir J. Eliot suggests.

From a discussion of the observations of variation of solar radiation, as indicated by the black bulb thermometer, Sir J. Eliot states that the data indicate that during 1891 to 1896 or 1897 there was an excess of solar radiant energy, and during 1898–1902 there was defect.

As such a defect would diminish the supply of aqueous vapour, and consequently the rainfall, accurate observations of the variations in solar radiation should give an explanation of the variations of the rainfall and air pressure. Observations by means of the black bulb solar radiation thermometers are, however, not considered very satisfactory.

Appendices to this important memoir give extracts from various official reports on the famines of 1897 and 1900 containing information with regard to the damage to crops and cattle. A large amount of data is also given referring to seasonal rainfall, rainy days, pressure, and dates of commencement and termination of the monsoon rains during the period discussed. Twenty-one plates of curves relating to the same observations form a not unimportant part of the volume which they conclude. W. M.

1 "Indian Meteorological Memoirs," vol. vi.
2 *Roy. Soc. Proc.*, vol. lxxi., p. 134.
3 *Roy. Soc. Proc.*, vol. lxx., p. 502.
4 *Roy. Soc. Proc.*, vol. lxxiii., p. 457

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

THE section of physiology concerned itself very largely with the consideration of questions which are of practical importance to workers in South Africa at the present time. Such diseases as scurvy, leprosy, and plague offer problems which demand instant consideration, and in some cases legislation. The treatment of these maladies formed the subject-matter of papers by the medical officer for Cape Colony and his staff.

The diseases of cattle are at present of great importance in South Africa; they played a prominent part in the proceedings, both at Cape Town and at Johannesburg. The fate of the four colonies, but especially of Rhodesia, is intimately bound up with their value for rearing horses, cattle, sheep, and goats. In recent years, and more especially since the importation of stock from all parts of the world during and after the Transvaal war, several forms of disease have attacked the domestic animals of South Africa. The severity of these diseases may be judged from the fact that 97 per cent. of the horses at Umtali died of horse-sickness in a recent epidemic. No more pressing problems, therefore, than the cause and prevention of stock diseases present themselves to the students of pathology in South Africa. At Cape Town the morning of August 17 was devoted to their consideration. Two important communications were given by Mr. Hutcheon, principal veterinary surgeon for Cape Colony, and Mr. Lounsbury, Government entomologist in Cape Colony. Mr. Hutcheon's great experience of the subject, extending as it does from a time when the parasitic nature of these diseases was unknown, and his constant and successful efforts to combat successive devastations, render his communication especially valuable. In recent years Mr. Lounsbury also has done a vast amount of first-class work in connection with the habits and life-history of the various forms of tick which act as intermediate hosts for the piroplasmic organisms. At Johannesburg a very comprehensive paper on rinderpest was given by the Hon. George Turner, and one of much interest on horse-sickness and similar maladies by Dr. Theiler, principal veterinary surgeon of the Transvaal. Colonel Bruce's presidential address dealt also with stock diseases.

The importance of South Africa as a health resort occupied the entire sitting of August 16. Sir Lauder Brunton opened a discussion upon the effect of climate upon disease and upon health. Dr. Gregory and other South African medical officials took part in this discussion. Results also of great scientific interest upon the effect of high altitudes on health were given by Prof. Bohr, of Copenhagen. Mr. Barcroft described the outcome of recent researches upon the production of heat in the individual organs of the body, and indicated the bearing of these investigations upon the heat-formation of the body under varying climatic and dietetic conditions.

The morning of September 1 was devoted to purely physiological topics.

Some of the more important communications may be summarised as follows:—

August 16.—Discussion on the effect of climate upon health. Sir T. Lauder Brunton, F.R.S., pointed out that three primary points had to be thought of in considering climate, its effect (1) on the human body; (2) on the organisms which give rise to disease; (3) on the carriers of disease. After a detailed investigation of the effects of change of environment upon protoplasm, he showed that for every cell there was an optimum degree of humidity and of salinity; but more important than these was the optimum temperature. When the temperature of the body fell below 98°·4, the vitality, not only of muscle, but of every other tissue, became reduced. The amount of heat produced depended upon the activity of the tissues; the loss of heat largely depended upon the environment (especially the temperature and the humidity). The nature of the soil greatly affected the humidity, but often pathological conditions were put down to the climate which were attributable in reality to the effect of the geological structure of a locality upon its water supply; for instance, the constipation experienced by many persons at sea-side resorts in the south of England was not due, as often supposed, to the sea air, but to the calcareous water. Electrical conditions were referred to, especially the observations of Wier Mitchell and Dexter in America.

Dr. Gregory pointed to the prevalence of tuberculosis in South Africa, of which 17 per thousand of the natives and 7 per thousand of the white population died annually. On the other hand, scarlatina, small-pox, typhoid, and influenza existed in much milder forms than in Europe.

Prof. Bohr, speaking of the effect of high altitudes upon health, introduced the results of his most recent investigations upon the invasion and evasion coefficients of oxygen in contact with liquid surfaces, and used these coefficients to calculate the minimum barometric pressure which was consistent with adequate respiration. He showed how compensation was carried out at low pressures, which, however, were higher than the absolute possible minimum. The full account of his investigations appears in Nagel's "Text-book of Physiology"—article on respiration—to which the reader is referred.

Mr. Barcroft dealt with the heat production in the organs of secretion and excretion, and showed that these organs were responsible for a much greater share of the heat produced in the body than was formerly supposed. The following figures might be taken as representing our present knowledge of the heat formation per gram per minute of certain organs when at rest:—The submaxillary gland, 0·2 calories; the kidney, 0·15 calories; skeletal muscle, 0·02 calories. In climates, therefore, where the opportunity for heat loss was small (*e.g.* hot-damp climates) these organs should not be unduly taxed.

Other speakers were Dr. A. J. Mitchell, Prof. Sims Woodhead, Dr. Murray, and Prof. Halliburton, F.R.S.

August 17.—Mr. Hutcheon, principal veterinary surgeon, gave an historical account of the diseases which had devastated the stock of South Africa—pleuropneumonia, redwater, rinderpest, east coast fever, biliary fever, horse-sickness, &c. Of these, heartwater, rinderpest, and horse-sickness were the results of ultramicroscopic blood-parasites, whilst the redwater of cattle and the east coast fever were definite piroplasmic diseases. Ticks were responsible for the communication of heartwater, redwater, and east coast fever; horse-sickness was probably communicated by a mosquito. Mr. Hutcheon went fully into the means that were now taken for preventing these diseases. In the cases of redwater, heartwater, and rinderpest inoculation had been successfully carried out.

Mr. Hutcheon attributed the absence of horses in South Africa to the fact that zebras took horse-sickness, but not fatally, and thus the infection was kept alive.

Mr. Chas. P. Lounsbury, Government entomologist for Cape Colony, treated of ticks as a means of transmission of disease. The main features in the economy of ticks were first discussed. *Amblyomma hebraeum* is the tick responsible for conducting the heartwater of goats, sheep, and cattle. It therefore prevents the successful farming of wooled sheep and Angora goats over a considerable tract of the country. The tick becomes infected at one stage of its life-cycle and communicates the disease at another. The requisite condition of warmth is necessary during the metamorphosis of the tick if the disease is to be communicated. Sheep of the Persian breed take the disease more mildly than other varieties, and the virus is somewhat modified by passing through them. The progeny of the transmitting tick appears to be innocuous. *Haemophysalis leachi* is responsible for the communication of canine piroplasmosis. Unlike *Amblyomma hebraeum*, this tick only communicates the virus by means of adults which are the progeny of infected females. The virus, therefore, passes through the egg, and remains latent in the nymphal and larval stages.

African east coast fever is communicated, like heartwater, by the nymphs or adults of ticks which have themselves fed upon a sick animal. Five species of the genus Eurhipicephalus, viz. appendiculatus, nitens, evertsi, simus, and capensis, have been proved to carry this disease.

Other speakers in this discussion were Colonel Bruce, F.R.S., Sir W. Hely-Hutchinson, Mr. Robertson, Prof. Sims Woodhead, and Mr. Bowhill.

August 18.—Dr. Gregory gave a comprehensive paper recounting the deductions which he had been able to make touching the nature of scurvy as it exists in South Africa.

His main thesis was that the scurvy of South Africa is infectious in its nature, and probably of bacterial origin. It is subject to seasonal variation; it occurs in epidemics which vary in the intensity of their virulence. Its incidence is greatest amongst the native races, and it has a very high percentage of recurrences. An anti-scorbutic diet does not prevent it. It occurs where the diet contains a plentiful supply of fish and vegetables, and does not necessarily occur where these foodstuffs are deficient.

Dr. Mitchell gave a detailed history of the plague epidemics in Cape Colony. He showed that the plague in every case was introduced by rodents, and suggested more stringent measures to prevent the introduction of infected animals.

Dr. R. S. Black, formerly physician to the leper asylum at Robben Island, gave an account of leprosy in South Africa. He dwelt on the accumulation of evidence which existed in favour of leprosy being an infectious disease, and the absence of any data which had come under his notice in favour of this disease being due to the eating of fish. In the discussion which followed the paper Prof. Sims Woodhead pointed out the importance to patients themselves, and to the State, of removing any ambiguity as to the infectious nature of leprosy. It could not be too clearly understood by the native population that the policy of segregation was not prompted by one of a number of rival theories, but was the result of established facts.

On August 19 some of those who had attended the section enjoyed the hospitality of the Cape Government at Robben Island, where they were shown the admirable arrangements for treating the lepers.

Johannesburg, August 29.—The proceedings of the section opened with the president's address. This has been printed *in extenso* in the columns of NATURE; it is therefore unnecessary to refer to it here further than to say that it struck the key-note of the whole work of the day's sitting. Colonel Bruce dealt very fully with the stock diseases of South Africa from the purely scientific side. Those whose papers followed (the Hon. George Turner and Dr. Theiler) dealt with rinderpest and other stock diseases from the point of view of the practical student of the problems which these diseases offered to the farmers and to the executive of the Transvaal. The urgency of the situation which was caused by the rinderpest epidemics and the success of the means which were used to cope with them are shown, as Mr. Turner pointed out, by the fact that 986,518 animals are estimated to have been saved by inoculation. Roughly, four thousand five hundred litres of serum have been used for the inoculation at a cost of 7*l.* 10*s.* per litre. In some herds the method of "simultaneous injection" of virulent blood and immunising serum has been so successful that only 14 per cent. of the cattle have fallen victims to the epidemic, whilst 1·3 per cent. have been killed by the injection.

Dr. Theiler's paper dealt with stock diseases generally; the fact, however, that his name is so intimately connected with recent advances of knowledge into the etiology and prevention of horse-sickness accentuated the interest of that part of his communication which dealt with this disease. Briefly summarised, horse-sickness especially occurs in low-lying districts during the rainy season. Animals are infected only at night. The infection ceases as soon as the frost comes. The disease is inoculable in animals of the same species, but is not contagious. Horse-sickness is distinct from "blaau tongue" or catarrhal fever, which closely resembles it in most of the above characteristics. The virus of horse-sickness is easily destroyed by desiccation, but it is not affected by cold. Both the above diseases are conveyed from animal to animal by insects. Veterinary Surgeon Spreuill has succeeded, by hyper-immunising sheep with virulent blood, in producing a serum which is efficacious in cases of "blaau tongue." The author has achieved immunity against horse-sickness in mules and horses by simultaneous subcutaneous injection of serum and intravenous injection of virus.

August 30.—An interesting feature of the work of the section, and one for which it is much indebted to the officials, was a visit to the compound hospital, presided over by Drs. Louis G. Irvine and Donald Macaulay. As an introduction to the inspection, a paper was communicated by Dr. Macaulay and Dr. Irvine upon the conditions of native labour in the mines. They pointed out the great difficulty of persuading the native workers to care for their own health, to take even the simplest precautions, for instance, on coming up from the deep mining levels into the cold air. The death-rate was much lower than formerly, but it was still very high as the result of pneumonia and phthisis. The main problem, however, is that of acclimatisation.

Other papers were read by Dr. Leingme on diseases of natives, Dr. Maberley on the pharmacology of South African drugs, and Prof. McKendrick, F.R.S., on the effect of radium on the electric currents of the retina.

September 1.—Prof. Waller, F.R.S., gave an account of his recent researches into the means of estimating the percentage of chloroform vapour in air by means of the densimeter. He showed how frequently the cause of death was due, not to idiosyncrasy of the patient, but to an unsuspected increase in the dose of chloroform. This might occur whatever method was used, but it was specially likely to happen when the so-called "Edinburgh method" of administration with a towel was used. His experiments had shown in theory what had already been proved by practice, namely, that a mask covered with donette delivered the proper percentage of chloroform to the patient, namely, 2 per cent.

Dr. Pavy, F.R.S., read a paper for which the thanks of the section are due to him in an unusually large measure. The main thesis was based upon Dr. Pavy's well known view that the comparatively small molecules into which the food is broken down in the intestine do not exist in the blood as such. This view is the result of so much practical experience of the treatment of diabetes and of so much careful thought and accurate work that it must always command the respect of physiologists if not their adherence. The part of Dr. Pavy's paper dealing with the mechanism which exists for building up such molecules as sugar into the larger molecules of which they form but a small part was of a much more speculative nature. The author's view was that this function was performed by the lymphocytes, which took up sugar, &c., much as hæmoglobin acquires oxygen. The sugar is thus built up into the molecules of living protoplasm, and is subsequently imparted to the plasma and indirectly to the body.

Dr. M. Armand Ruffer gave a brief account of the evolution of the present knowledge of immunity artificially acquired. His own researches show that the serum of rabbits injected with human, bovine, or ovine urine dissolves *in vitro* the red blood corpuscles of that species of animals the urine of which has been injected. It is specific, *i.e.* has no action on the red blood corpuscles of any other species of animals. The author calls lysogen the substance which, when injected, produces a hæmolytic serum. Lysogen dialyses slowly, is not precipitated completely by alcohol, but wholly by saturation with ammonium sulphate or lead acetate. Simple exposure to air for one month or more destroys it, though it resists putrefaction and is not wholly destroyed by a temperature of 100° C. Urine contains hæmosozin or hæmosozins, *i.e.* a substance or substances preventing the action of hæmolytic serum. Some urines, *e.g.* human urine, prevent the action of serum dissolving human, bovine, and ovine red blood corpuscles; others, *e.g.* bovine urine, act only on a serum dissolving bovine red blood corpuscles. Dialysed urine is just as active as ordinary urine. Hæmosozin has practically the same physical and chemical characteristics as lysogen. Bile contains at least two groups of hæmolysins, and at least one hæmosozin. This hæmosozin is specific, *i.e.* prevents the hæmolytic action of the bile of that species of animals from which the hæmosozin was extracted, but not the biliary hæmolysins of any other species of animals.

The paper concluded by pointing out the necessity of making sera with isolated substances, and not with the crude products of bacteria. By injecting crude products it is more or less a matter of chance what the properties of the serum will be.

The proceedings ended at Johannesburg, as they had done at Cape Town, with an expression of thanks to the local officials of the section who had taken infinite pains to bring the meetings up to the high level of interest which they attained. J. BARCROFT.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—This week twelve of the larger colleges are holding their entrance scholarship examinations. They are divided into two groups of five and seven colleges respectively. Judging from the number of candidates, which is larger than ever before, there is an unprecedented desire amongst schoolboys to share in the endowments of Cambridge.

The annual dinner of the Cambridge Philosophical Society will take place on Saturday, December 9. It will be held in the hall of Christ's College, and Prof. Marshall Ward will be in the chair.

The regulations for the diploma in mining engineering have been published in the *Reporter* by the special board for physics and chemistry, together with the schedules of the proposed examinations.

The general board of studies has approved Dr. W. L. H. Duckworth, of Jesus College, for the degree of Sc.D.

The special board for biology and geology has adjudged the Walsingham medal for 1905 to Mr. W. S. Perrin, of Gonville and Caius College.

THE new buildings of the Glasgow and West of Scotland Technical College, which when completed will be the largest of the kind in Great Britain, are to be opened by the Marquess of Linlithgow, Secretary for Scotland, on December 21.

WE learn from *Science* that by the will of the late Mr. Joseph E. Gillingham, numerous bequests are made to educational institutions, including 10,000*l.* each to the University of Pennsylvania for the veterinary department, to Haverford College, to Swarthmore College, and to Bryn Mawr College.

THE *British Medical Journal* announces that Prof. Czerny has resigned the chair of surgery in the University of Heidelberg, which he has held since 1877, in order to devote himself entirely to the duties of director of the Institute of Cancer Research. He will be succeeded in the chair of surgery by Prof. Garré, who accepted a call to Breslau after the death of Prof. von Mikulicz.

A FEW months ago Sir Donald Currie offered a sum of 20,000*l.* to Queen's College, Belfast, provided a like sum was contributed by the friends of the college before the end of the present month. The sum of 3000*l.* was required to complete this contribution, and this has now been subscribed by Sir Otto Jaffe, chairman of the executive committee of the better equipment fund of Queen's College. The college will therefore now receive 40,000*l.* toward its better equipment.

AT the annual meeting of the court of Liverpool University on November 30, the Pro-Chancellor announced that the university would shortly receive from the executors of the late Mr. J. L. Bowes, of Liverpool, a sum of about 8000*l.*, to be divided between the departments of modern languages and chemistry. A resolution was adopted to the effect that the decision of the court as to the formation of a school of military instruction be deferred until the court is in possession of fuller information as to the need of such a proposed school, and that meanwhile the council be requested to take no further steps towards its establishment.

THE new techno-chemical institute of the Charlottenburg Technical High School was opened on November 25 in the presence of a distinguished scientific audience, which included the Imperial Minister of Education, Dr. Studt, accompanied by Geh. Rat. Naumann and Freiherr von Thielmann, Profs. Emil Fischer, van 't Hoff, Landolt, Nernst, Beckmann, Will, von Knorre, Liebermann, and the following representatives of chemical industries:—Prof. Duisberg, Prof. Lepsius, Dr. Oppenheim, Dr. Knietsch, Dr. von Martius, Dr. Kunheim Kommerzienrat Brunck, Messrs. Birkeland, Eyde, Pettersson, and others. The new institute is a fine five-storeyed building, excellently equipped with the best of modern chemical laboratory arrangements and apparatus. The director, Prof. Dr. O. N. Witt, in his opening address, after dwelling upon the history and the aim of this, the newest addition to the Charlottenburg High School, detailed Birkeland and Eyde's method for the fixation of atmospheric nitrogen, and illustrated his account by an experiment carried out on a large scale. After the address the Educational Minister, Dr. Studt, decorated Prof. Witt with the Order of the Red Eagle, third class, and the architect, Dr. Körber, with the Order of the Red Eagle, fourth class.

A DEPUTATION from colleges connected with the teaching of agriculture who desired additional grants for research and higher education in agricultural science from the Imperial Exchequer was received by Sir Thomas Elliott at the Board of Agriculture on Tuesday. Sir Isambard Owen, the principal of the Armstrong College, Newcastle-upon-Tyne, stated the case on behalf of the deputation. It was urged that higher agricultural education was a public necessity, the cost of which could not be reasonably expected to be met in a very large proportion from local sources, and that they were amply justified in asking for State assistance. Sir Thomas Elliott, in reply, said that the Treasury had not hitherto met the demands of agriculturists illiberally altogether. Fifteen years ago the grant was 4500*l.*, and now it was 10,550*l.* Of course, it was difficult to get increased local contributions owing to the increase of educational burdens upon local authorities. He quite agreed with the deputation that there was great room for the development of scientific research. There were great problems to be solved of an economic character which would produce results far beyond the cost of investigation or experiments. He thought the time had come for the coordination of the various agencies for agricultural research in this country. The Board had the fullest sympathy with the work which the colleges had done, and he hoped it would be able in some measure to meet their aspirations.

AT the winter session last week the General Medical Council considered the report of the education committee on the question whether the adoption of the following resolutions would not help to secure the attainment of the object which the council had in view in instituting the five years' curriculum:—"(1) That the preliminary scientific examination in physics, biology, and chemistry should be passed before the student begins the qualifying study of anatomy and physiology; (2) that before being admitted to the final examination the student should produce evidence that he has devoted the last year of his curriculum exclusively to practical and clinical work and study." The committee reported that the main effect of the proposed change would be seriously to lengthen the curriculum and thus to render entrance to the profession more difficult and expensive. At present the curriculum is far more often one of six or even more years—and this even in the case of industrious students—than one of five. With regard to the second resolution, the committee held that distinct evidence of clinical and practical study in the fifth year should be produced by the student, showing that his time in that period of his curriculum had been mainly occupied in such work, but they would not suggest any regulation which should absolutely limit the work of each session of the period of professional study. Dissatisfaction was, however, expressed with the committee's report, and the subject is to be re-considered. The two following questions were referred to the education committee to be investigated and reported upon:—(1) As to the desirability of transferring the preliminary science subjects of physics, biology, and chemistry from the curriculum of medical studies to a stage preliminary to the commencement of the curriculum; and (2) as to the advisability of requiring a five years' period of study, even after removing from the curriculum these preliminary science subjects.

THE report of the Board of Education for the year 1904–5 has now been published. After a general review of the work of the Board, detailed particulars of the following classes of schools are given in order:—public elementary schools, secondary schools and technical institutions, evening schools and schools of art. In the section dealing with secondary schools, the report lays it down that, "although it would be inexpedient and unjust to withdraw approval, and the support hitherto given, from those schools which have already been organised with a curriculum which is specialised from the first on the side of applied science, if

it can be shown that such a course is suitable to the circumstances of the locality in which the school is placed, yet it is not the intention of the Board to sanction the adoption of this special course in any fresh school." This decision is a little difficult to understand. If it can be shown at present that some schools, in which science takes a specially prominent part, are suitable to the locality in which the school is placed, it would appear reasonable to suppose that other localities in the future may demonstrate the need for a precisely similar type of school, and yet the Board has decided beforehand that—such demonstration notwithstanding—there shall be no more such schools. Experience has shown that the so-called "school of science" is capable of supplying just the training boys from elementary schools in manufacturing centres require to prepare them for their work in life, and it is to be hoped in these cases that every encouragement will be given to a definite course of study in science in the schools. All educationists of experience agree with the Board's opinion, expressed in subsequent paragraphs of the report, that premature specialisation in the work of ordinary secondary schools is to be discouraged, and that a well balanced curriculum, comprising literary and practical subjects taught in a scientific manner, is of prime importance; but such agreement does not preclude the possibility of applying special remedies to special needs. It is satisfactory to find that the report contains abundant evidence of a continued improvement in the work of secondary schools and technical institutions.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 16.—"The Transit of Ions in the Electric Arc." By A. A. Campbell **Swinton**. Communicated by the Hon. C. A. Parsons, C.B., F.R.S.

The paper describes an experiment designed to show that in the electric arc the positive and negative electrodes emit carriers or ions which are respectively positively and negatively charged, and, after travelling across the arc, bombard the opposite electrode. The method adopted resembles that employed by Perrin to prove the negative charge carried by kathode rays. A small hole was pierced axially through one of the carbon electrodes, and immediately behind this aperture was fixed an insulated Faraday cylinder of brass which had its aperture in line with, and facing the aperture in, the electrode. A galvanometer connecting the insulated cylinder and the pierced electrode measured any difference of potential between the two. The second electrode was an ordinary carbon pencil, and as this was made positive or negative it was found that positive or negative charges respectively were communicated to the insulated Faraday cylinder, provided the arc covered the aperture in the pierced electrode, but not otherwise. These results, which confirm the theory as enunciated above, were obtained both in air at atmospheric pressure and also *in vacuo* up to what could be obtained with a mechanical air pump. The galvanometer deflections increased considerably with the degree of exhaustion, and at any given degree a much larger deflection was obtained when the second electrode was made negative and the cylinder was being charged negatively than when the contrary was the case, this corresponding with the known fact that negative ions have a higher velocity than have positive ions.

Geological Society, November 8.—Dr. J. E. Marr, F.R.S., president, in the chair.—The coast-ledges in the south-west of the Cape Colony: Prof. E. H. L. **Schwarz**. The author compares the shelves of Cape Colony with those described on the European and American sides of the North Atlantic, and he places the "absolute base-level of erosion" at 12,000 feet in North America, 8000 feet in Europe, and 1200 feet in South Africa. With these varying heights he correlates the topography of the bordering continents—the sharp divides, open river-valleys, permanent rivers and deltas, of Europe and America, where the movement has been downward and has almost reached bottom, in contrast with the flat undenuded divides, the steep, narrow gorges, the waterfalls, and the rocky river-gates, of South Africa, which is on the upgrade and probably near the top.—The Glacial period in Aberdeenshire and the southern border of the Moray Firth: T. F. **Jamieson**. One of the most interesting features in the glacial geology of Aberdeenshire is the Red Clay found along the eastern coast of the county. The purer masses of clay seem to have formed in a sheet of water lying in front of the ice, between it and the land, during the retreat of the Aberdeenshire ice, and at a time when the coast was submerged beneath water to a level exceeding 300 feet above the present coast-line. Evidence of the northward motion of the ice is given from striæ, the transport and removal of flints, and the bending-over of the edges of folia of gneiss. The Red Clay is underlain by a Grey Clay, and sometimes covered by a similar one. The author has recently discovered remains of a still older, dark indigo in colour, and containing small fragments of sea-shells. On the southern border of the Moray Firth the author gives examples of glacial marking on the rocks, and refers to the transport of boulders, including a huge mass of Oolitic rocks 40 feet thick, a mass of clay once considered to be an outlier of Lias, "pipe-rock," and the fossiliferous Greensand débris at Moreseat, now considered to have been transported by ice.

November 22.—Dr. J. E. Marr, F.R.S., president, in the chair.—On a new specimen of the chimæroid fish *Myriacanthus paradoxus*, Ag., from the Lower Lias of Lyme Regis (Dorset): Dr. A. S. **Woodward**. The author, having proved that the dorsal fin-spine of the so-called *Ischyodus othorhinus* is identical with an ichthyodorulite which has been named *Myriacanthus granulatus*, inferred that the larger ichthyodorulite *M. paradoxus* belonged to the same fish as the larger dentition named *Prognathodus Guentheri* by Egerton. This question has been settled by the discovery by Mr. S. Curtis, in the Lower Lias of Black Ven, of a dorsal fin-spine in direct connection with a mass of decayed cartilage, dermal plates, and teeth. The new fossil warrants the conclusion that Myriacanthus is a chimæroid, closely similar to the Upper Jurassic Chimæropsis, with (1) a median chisel-shaped tooth in front of the lower jaw; (2) a few tuberculated dermal plates on the head; and (3) a tuberculated dorsal fin-spine. In these respects it differs from all other known chimæroids—even from the comparatively primitive types which have been discovered during recent years in the Japanese seas. The Myriacanthidæ, in fact, have still no nearer ally than Callorhynchus, with which Egerton originally compared his so-called *Ischyodus orthorhinus*.—The rocks of the cataracts of the River Madeira and the adjoining portions of the Beni and Mamoré: Dr. J. W. **Evans**. The crystalline rocks of the cataracts of the River Madeira and the lower waters of its tributaries are part of a ridge with a north-westerly and south-easterly strike, similar to that of the Andes in the same latitudes. This strike is especially prevalent in equatorial regions. With the exception of comparatively recent alluvial deposits and a few pebbles of chert, pronounced by Dr. G. J. Hinde to be of marine origin, but uncertain date, only crystalline rocks are met with in the falls. They all appear to be igneous, and are mostly massive in character, though some dyke-rocks occur. In places they are typical gneisses, and they are often banded, but in some cases they show no signs of foliation. The prevailing type is acid, with a considerable proportion of alkalies, especially soda; but some of the rocks are distinctly basic in character.—The Doncaster earthquake of April 23, 1905: Dr. Charles **Davison**. The Doncaster earthquake of 1905 was a twin, with its principal epicentre half a mile north of Bawtry, and the other about 4 miles east of Crowle and close to the centre of the disturbed area of the Hessle earthquake of April 13, 1902. The distance between the two epicentres is about 17 miles. The disturbed area contains about 17,000 square miles, including the whole of the counties of Lincoln, Nottingham, Derby, Stafford, Leicester, and Rutland, the greater part of Yorkshire, and portions of Lancashire, Cheshire, Shropshire, Worcestershire, Warwickshire, Northamptonshire, Cambridgeshire, and Norfolk. The originating fault runs from about E. 38° N. to W. 38° S., and appears to be nearly vertical within the south-western focus and inclined to the south-east in the north-eastern focus. The first and stronger movement took place within the south-western focus. A twin-earthquake

is probably due to the differential growth of a crust-fold along a fault which intersects it transversely, the first movement, as a rule, being one of rotation of the middle limb, accompanied by the almost simultaneous slip of the two arches, and followed soon afterwards by a shift of the middle limb.

Zoological Society, November 14.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—*Exhibitions.*—(1) The mounted head and skin of a white water-buck (*Kobus ellipsiprymnus*) from British East Africa; (2) two mounted heads of the rhinoceros, one of which showed abnormal growth of the anterior horn, whilst the other bore four horns, viz. two on the nose, one between the ears, and one nearly at the back of the head: Colonel W. H. **Broun.**—(1) Specimens of a very rare and interesting marsupial, hitherto unique, in the Paris Museum, viz. *Dactylopsila palpator*, Milne-Edw., which differed from *D. trivirgata* by the extremely thin prolonged second finger; (2) two tusks which had been obtained by Baron Maurice de Rothschild during his recent expedition to Abyssinia: Hon. W. **Rothschild.**—Microscopic preparations of a new hæmosporidian from the blood of an African stork (*Leptoptilus crumeniferus*): A. S. **Hurst.** The exhibitor pointed out that this parasite belonged to the genus Halteridium, but differed from *H. danilewskyi* in its greater size (stade moyen 7–10 μ), and also in its method of sporulation, in which the merozoites were more numerous, smaller, and arranged in a ball-like rounded mass. The name *Halteridium crumenium* was proposed for the new species.—A letter from Mr. William Rodier, of Tambua Station, Cobar, N.S.W., concerning the continued success of Mr. Rodier's plan for counteracting the rabbit pest: Dr. P. L. **Sclater.** The plan consisted simply in catching the rabbits alive and killing the females only, letting the males go free.—The *Satyrus indicus* of Tulpius, said to be the type of the genus Simia: H. **Scherren.** Remarks were made with the view of showing that the animal was a gorilla, and was recognised before the middle of the eighteenth century as differing from a chimpanzee. The distinction between the *tschego* and the *ngina* was, he said, known in England in the first quarter of the nineteenth century.—*Papers.*—On the papillary ridges in mammals, chiefly primates: Dr. W. **Kidd.** The arrangements of the ridges on the hand and foot of twenty-four species were shown and described, and their functions discussed. Arguments were brought forward to show that their primary function was to increase the delicacy of the sense of touch.—On the mammals brought back by the Tibet Mission: J. L. **Bonhote.** The collection was very small, containing examples of only some eight species, three of which were described as new, viz.:—(1) *Vulpes vulpes waddelli*, subsp.n. Similar to *V. v. flavescens*, but the whole coloration much brighter, especially the median dorsal area, which was deep red and markedly distinct from the colour of the flanks. (2) *Cricetulus lama*, sp.n. Allied to *C. phaeus*, but much greyer in general coloration, and the tail somewhat longer and stouter. (3) *Microtus* (*Phacomys*) *waltoni*, sp.n. Closely allied in skull characters to *Ph. blythi*. The general coloration, however, was fulvous-grey, slightly greyer over the anterior part of the body.—Notes on the geographical distribution of the okapi: Dr. E. **Lönnberg.**—Observations on the Goral (*Cemas goral*) in Burma: Major G. F. **Evans.**—A collection of the mammals of Crete: Miss D. M. A. **Bate.** Examples of sixteen forms, of which six were described as new subspecies, were contained in the collection, and these were enumerated and remarked upon in the paper.

Physical Society, November 24.—Prof. J. H. Poynting, F.R.S., president, in the chair.—The dielectric strength of air: A. **Russell.** The author makes the assumption that for distances apart greater than about a millimetre when the disruptive voltage is V kilovolts the effective P.D. between the ends of the Faraday tube which is subject to the maximum stress is $V-\epsilon$, where ϵ is the minimum sparking voltage. Applying formulæ which he has deduced, using this assumption, to tests of Heydweiller, Steinmetz, Algermissen, &c., the author finds that they agree in making the dielectric strength of air 38 kilovolts per cm. approximately. A knowledge of this quantity enables us to find, not only the disruptive voltages between electrodes of many geometrical shapes, but it also enables us to find the "critical" pressure for overhead electric-power transmission at high pressures.—On the electrical conductivity of flames for rapidly alternating currents: Dr. H. A. **Wilson** and E. **Gold.** The following is a summary of the results:—(1) For rapidly alternating currents a flame containing an alkali salt vapour behaves like an insulating medium of high specific inductive capacity. (2) The conductivity of different alkali-salt vapours in a flame for rapidly alternating currents, as measured by the apparent capacity of platinum electrodes immersed in the flame, varies as the square root of the conductivity of the same salt vapours for steady currents. This result confirms the view that the negative ions from all salts have the same velocity. (3) The apparent capacity varies nearly inversely as the square root of the maximum applied P.D. (4) The apparent capacity is nearly independent of the number of alternations per second. (5) The apparent capacity is nearly independent of the distance between the electrodes. (6) The results (1) to (5) are in agreement with the ionic theory of the conductivity of the flame for rapidly alternating currents when the velocity of the positive ions and the inertia and viscous resistance to the motion of the negative ions are neglected in comparison with the effects due to the number of ions per c.c. (7) The apparent capacity per sq. cm. area of the electrodes is equal to $\sqrt{ne/8\pi V_0}$, where n is the number of positive ions per c.c., e the charge on one ion, and V_0 the maximum applied P.D. (8) Not more than one molecule in ten of salt molecules is ionised at any instant, but each molecule is probably ionised and re-combines several million times per second. (9) The steady currents observed through salt vapours in flames are very far from the maximum possible currents corresponding to the number of ions produced per second.—On the lateral vibrations of loaded and unloaded bars: J. **Morrow.** This is a continuation of the work previously communicated by the author on the vibration of bars of uniform and varying sectional area. By means of a method of continuous approximation the elastic displacement curves and the frequency of the lateral vibrations of bars can be determined to any required degree of accuracy. The method is first applied to some cases of unloaded bars, and also to massless bars carrying concentrated loads. The paper then deals with the principal problems of loaded bars which are themselves of appreciable mass.

MANCHESTER.

Literary and Philosophical Society, October 31.—Prof. W. Boyd-Dawkins, F.R.S., vice-president, in the chair.—On a biological aspect of cancer: F. J. **Faraday.** The author directed attention to a paper with this title read by him in 1899, and printed in vol. xliii. of the society's *Memoirs*. Several of the conclusions recently arrived at by the cancer research committee were therein foreshadowed, *e.g.* that cancer is not a microbic disease, but is due to an arrest of development and differentiation among the somatic cells, growth being restricted to mere gemmation.—Some recent researches into the nutrition of the egg cell in certain plants: Dr. Marie C. **Stopes.** The special group of plants on which the author worked was that including the pine trees, Ginkgo, and the Cycads, viz. the Gymnosperms. Though the egg cells in this group are in many ways different from those of the flowering plants, the results have some bearing on the question of nutrition of egg cells in general, as well as some points of general technique. Much of the work was done in conjunction with Prof. Fujii, of Tokio, with whom the author is publishing a joint paper on the subject in Germany.—A model to illustrate the propagation of sound waves: Dr. H. **Ramsden.** The model consists of a series of magnetised needles, suspended vertically so as to vibrate in the same plane with their like poles downwards, and is designed to show (since the needles were constructed and regulated to have equal times of oscillation) most of the phenomena of the longitudinal transmission of waves.

November 14.—Sir W. H. Bailey, president, in the chair.—Seaweed: C. L. **Barnes.** The author read some extracts from the classical writers which showed in how little esteem seaweed was held by the ancients, it being regarded by them as the most useless of things. He then showed, by an enumeration of some of the uses to which

seaweed is now put, that the moderns had effectually removed this reproach that had been put upon it.—An experiment showing some convection effects in a heated liquid: C. H. **Burgess.** A U-tube is filled in the lower half with hydrochloric acid coloured by a dye, and in the upper with plain acid, and the liquids are allowed to diffuse so as to give a shaded band. The liquid is then heated by the passage of an electric current, and is resolved into a series of well marked layers.

PARIS.

Academy of Sciences, November 27.—M. Troost in the chair.—On the distillation of copper: Henri **Moissan.** Copper can be readily distilled in the electric furnace. When the vapour is condensed on a cool body, a felted mass of copper filaments is obtained, presenting all the properties of ordinary metallic copper. Copper at its boiling point dissolves carbon, graphite, partly crystalline and partly amorphous, separating out on cooling.—On the benzylidene derivatives of anthrone and anthranol: A. **Haller** and M. **Padova.** Amongst the reduction products of anthraquinone, Liebermann isolated a compound $C_{14}H_{16}O$, to which one of two formulæ could be assigned. The reactions described in the present paper show that this behaves as a tautomeric body, giving rise to derivatives of the ketone, anthrone.—Researches on intensive nitrification: A. **Muntz** and E. **Laine.** The principal aim of the present research was to find out a means of producing nitre on a large scale for the manufacture of explosives. Animal charcoal has been found to be the best support for the nitrifying organism when strong solutions of ammonium salts are employed, a litre of animal charcoal giving 8·1 grams of nitre per day. The maximum concentration of ammonium sulphate permissible has been found to be 7·5 grams per litre. It is shown that it would be possible to produce nitrates in quantities sufficient for the manufacture of explosives in the case of the external supply being stopped.—On the total eclipse of the sun of August 30, 1905: Ch. **André.** It is shown that the study of the eclipse by a series of micrometric measurements gave results at least as good as the direct determination of the times of the external contacts.—On the luminous intensity of the solar corona during the total eclipse of August 30, 1905: Charles **Fabry.** The observations were carried out at Burgos with a Lummer photometer. The intensity found was about three-quarters that of the full moon.—On groups of continuous curves: Maurice **Fréchet.**—On the non-uniform divergence and convergence of Fourier's series: H. **Lebesgue.**—On the coefficient of utilisation of helices: Edgar **Taffoureau.** A motor of 205 horse-power, working two helices of 7·767 metres diameter, can sustain a useful weight of 506 kilograms.—On the definition of the magnifying power of microscopical objectives: L. **Malassez.** The author proposes to define the magnifying power as the magnification produced by the objective at unit distance from its posterior face.—Researches on the purity of electrolytes. The determination of an upper limit of hydrolysis of concentrated saline solutions by the use of symmetrical liquid chains presenting a fresh surface of contact: M. **Chanoz.**—The difference of potential under which the kathode rays are produced: Jean **Malassez.** The author's experiments tend to show that, contrary to the views put forward by J. J. Thomson, the difference of potential under which the kathode rays are produced is the difference actually existing between the anode and the kathode.—The decomposition of ammonium sulphate by hot sulphuric acid in the presence of platinum: Marcel **Delépine.** In the presence of platinum, ammonium sulphate is destroyed by boiling sulphuric acid. The fact has an important bearing on the determination of nitrogen by the Kjeldahl method.—On a commercial silicide of copper: Paul **Lebeau.** A commercial specimen of copper silicide contained 51 per cent. of free silicon, 44 per cent. of copper silicide, and 4 per cent. of silicide of iron. The silicide was isolated, and, contrary to the accepted view, and in spite of the excess of free silicon, was found to consist of $SiCu_4$ instead of $SiCu_2$.—Chemical oxydases acting in the presence of hydrogen peroxide: G. **Baudran.**—The molecular refraction and dispersion of compounds containing the acetylenic grouping: Charles **Moureau.** It is shown that the additive law in the case of the molecular refraction and dispersion of substituted acetylenes does not correspond with the experimental facts.—The petrographical examination of some volcanic rocks from the Tuamotou Islands and Pitcairn Island: Albert **Michel-Lévy.**—On sterile fruits developed without the intervention of the male element: Th. **Solacolu.** The reserves accumulated at the base of the flower or in the neighbouring parts with a view to the normal development of the pistil after fertilisation are utilised in certain species, even when fertilisation has not taken place, with the formation of a false fruit.—On a new enemy of the coffee plant in New Caledonia: I. **Gallaud.** The disease is known locally as *Koleroga* or *Candellilo*, and is caused by a fungus, *Pellicularia Koleroga*.—Statistical researches on the evolution of the height in flax: Mlle. M. **Stefanowski** and M. Henri **Chrétien.**—The cervical covering in the nauplius stage of *Artemia salina*: Nicolas **de Zograf.**—On a supposed case of reproduction by budding in annelids: Ch. **Gravier.**—The trophoplasmic spherules of the ciliated infusoria: J. **Kunstler** and Ch. **Gineste.**—Researches on a supposed ovulase of spermatozoids: Antoine **Pizon.** Pieri's theory, that the segmentation of the egg is started by a ferment (ovulase) of spermatic origin, has been examined experimentally under more rigorous conditions than those obtaining in Pieri's original experiments, and no evidence of the existence of such a ferment was obtained. The author's conclusion is that Pieri's experiments were not carried out with sufficient care.—The toxic power of the seminal fluid and general considerations on the poisonous character of the genital products: Gustave **Loisel.**—On the influence of the salts intimately related to the albumenoids and to the diastatic materials in proteolysis: G. **Malfitano.**—On the function of salts on the production of activity in the pancreatic juice: the specific action of calcium: C. **Delezenne.**—The oxidation of organic substances by ferrous sulphate in the presence of extracts of animal tissues: F. **Battelli.**—The emersion of the land during the Cretaceous period in Greece: Ph. **Négris.**—On the geological structure of the Cantabrian Cordillera in the province of Santander: Pierre **Termier.**—On the Carboniferous and Permian deposits in Corsica: M. **Deprat.**—The layer of fossil vertebrates of Maragha: M. **de Mecquenem.**—Measurements of the intensity of the earth's electric field and of the ionisation of the atmosphere during the total eclipse of the sun of August 30, 1905: G. **Le Cadet.**

CALCUTTA.

Asiatic Society of Bengal, November 1.—Some remarks on the geology of the Gangetic plain: E. **Molony.** The present valley of the Ganges in the United Provinces of Agra and Oudh has been excavated from an older alluvium, the eroding power of the river being due to submergence in the lower part of the course of the river at some remote period. The older alluvium sometimes forms islands in the midst of the newer alluviums, or Khadir, and is characterised by the presence of nodular limestone (Kankar). The boundary between the two formations is usually distinct. The main direction of the course of the river is determined by the channels in the older alluvium, erosion in which takes place very slowly. In stiff clay the average rate is 11 feet per annum. The records of the Lucknow boring indicate that the strata at a depth of more than 1000 feet are inclined, probably from north to south, and this is taken as evidence of a relative submergence of the southern portion of the Gangetic plain.—Note on the species, habits, and external characters of the dugong: Dr. N. **Annandale.** The author has examined a considerable series of Indian and Australian skulls and skeletons of Halicore. He regards the differences between them as individual, and sees no reason to recognise more than one species, *H. dugong*. He gives the measurements of a fully adult male recently caught in the Gulf of Manaar, and describes its external characters, especially those of the head and mouth. He points out that the dugong has probably altered its habits considerably within the last half-century, at any rate in Indian waters, and shows that its food includes true algæ.—*Hedyotis sisaparensis*, a hitherto undescribed Indian species: Captain A. T. **Gage.** Description of a new species of Hedyotis found by the author in the Calcutta Herbarium, from the Nilgiri district. It is most nearly related to *H. mollis*

(Wall.).—Materials for a flora of the Malayan Peninsula, No. 18: Sir George **King**, K.C.I.E., F.R.S., and J. S. **Gamble**, F.R.S. Owing to an unforeseen cause of delay, it has been found necessary to postpone the publication of the natural orders No. 75, Apocynaceæ, No. 76, Asclepiadaceæ, and No. 77, Loganiaceæ, for a short while; consequently the present part, No. 18 of the "Materials for a Flora of the Malayan Peninsula," contains the orders which succeed, viz. No. 79, Hydrophyllaceæ, to No. 85, Lentibulariaceæ, inclusive, together with No. 87, Bignoniaceæ, and No. 88, Pedalinceæ. No. 78, Gentienaceæ, has already appeared in part xvii., and No. 86, Gesneraceæ, will come later on.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 7.

ROYAL SOCIETY, at 4.30.—The Periodogram and its Optical Analogy; with an Illustration from a Discussion of Observations of Sun-spots: Prof. A. Schuster, F.R.S.—(1) On a Property which holds good for all Groupings of a Normal Distribution of Frequency for two Variables, with Applications to the Study of Contingency-tables for the Inheritance of Unmeasured Qualities; (2) On the Influence of Bias and of Personal Equation in Statistics of Ill-defined Qualities: an Experimental Study: G. Udny Yule.—On the Inheritance of Coat-colour in Horses: C. C. Hurst.—Further Experiments on Inheritance in Sweet Peas and Stocks (Preliminary Account): W. Bateson, F.R.S., E. R. Saunders, and R. C. Punnett.—A Biometrical Study of Conjugation in Paramæcium: Dr. Raymond Pearl.—On Mathematical Concepts of the Material World: A. N. Whitehead, F.R.S.—The Determination of the Osmotic Pressure of Solutions by the Measurement of their Vapour Pressures: The Earl of Berkeley and E. G. Hartley.—The Vertical Temperature Gradients on the West Coast of Scotland and at Oxshott, Surrey: W. H. Dines, F.R.S.—The Combination of Hydrogen and Oxygen in contact with Hot Surfaces: Dr. W. A. Bone, F.R.S., and R. V. Wheeler.—Fifth and Sixth Catalogues of the Comparative Brightness of the Stars: in Continuation of those printed in the *Phil. Trans.* for 1796-99. (Prepared for press from the original MS. Records by Colonel J. Herschel, R.E., F.R.S.): The late Dr. Herschel, F.R.S.—On the Cytology of Malignant Growths: Prof. J. B. Farmer, F.R.S., J. E. S. Moore, and C. E. Walker.—A Gas Calorimeter: C. V. Boys, F.R.S.

SOCIETY OF ARTS, at 4.30.—The Partition of Bengal: Sir James A. Bourdillon, K.C.S.I.

CHEMICAL SOCIETY, at 8.30.—The Constitution of Nitrites, Part I., Two Varieties of Silver Nitrite: P. C. Rây and A. C. Ganguli.—The Products of Heating Silver Nitrite: E. Divers.—Ethyl Piperonylacetate: W. H. Perkin, Jun., and R. Robinson.—A Contribution to the Chemistry of Saccharin: F. D. Chattaway.—The Action of Heat on α-Hydrocarboxylic Acids, Part II.: H. R. Le Sueur.—Studies on Optically Active Carbimides, Part II., The Reactions between 1-Menthylcarbimide and Alcohols: R. H. Pickard, W. O Littlebury, and A. Neville.—The Action of Ultra-violet Light on Moist and Dried Mixtures of Carbon Monoxide and Oxygen: S. Chadwick, J. E. Ramsbottom and D. L. Chapman.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Charing Cross Company's City of London Works: W. H. Patchell.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Concrete Mixers: Dr. J. S. Owens.

LINNEAN SOCIETY, at 8.—On the Ætiology of Leprosy: Dr. Jonathan Hutchinson, F.R.S.—Some Notes on the Life-history of *Margaritifera Paneseae*: A. W. Allen.—*Exhibition*: Photographs of a Luxuriant Specimen of *Shortia uniflora*, in the Rock-garden of Mr. W. T. Hindmarsh, at Alnwick.

RÖNTGEN SOCIETY, at 8.15.—The Spontaneous Action of Radium and other Bodies on Gelatin Media: J. Butler Burke.

FRIDAY, DECEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Results of Recent Investigations Relating to Sun-spot Periods: Prof. A. Schuster.—On the Present State of Lunar Nomenclature: S. A. Saunder.—On a New Method of Determining the Moon's Position Photographically: E. B. H. Wade.—Reproduction photographique des Réseaux photographiques: H. Bourget.—(1) Position of the Axis of Mars: (2) Comparative Charts of the Region following δ Ophiuchi: Percival Lowell.—Comparison of the Results from the Falmouth Declination and Horizontal Force Magnetographs on Quiet Days in Years of Sun-spot Maximum and Minimum: Dr. Charles Chree.—Note on the Astronomical Value of Ancient Statements of Solar Eclipses: Prof. Simon Newcomb.—On the Conditions Determining the Formation of Cloud Spheres and Photospheres: A. W. Clayden.—On Testing Parabolic Mirrors; with some Results of the Tests as Applied to some Mirrors at Oxford: Rev. C. D. P. Davies.—*Promised paper:* On the Astronomical Observations recorded in the Nihongi, the Ancient Chronicle of Japan: E. B. Knobel.

MALACOLOGICAL SOCIETY, at 8.—(1) A Revision of the Species of Cyclostomatidæ and Liotiidæ occurring in the Persian Gulf and North Arabian Sea; (2) Description of Two Species of Marine Shells from Ceylon: J. Cosmo Melvill.—A Pteropod Alias: (*a*) C. Hedley, (*b*) E. R. Sykes.—(1) Descriptions of Four new Species of Marine Shells from Ceylon; (2) Description of a new Species of Physa from N.W. Australia: H. B. Preston.—Notes (1) on the Dates of Publication of J. D. Wilhelm Hartmann's "Erd- und Süsswasser-Gasteropoden," 8vo, St. Gallen, 1840; (2) On Some "Feeding Tracks" of Gastropods: (3) On Cement as a Slug-killer: B. B. Woodward.

MONDAY, DECEMBER 11.

SOCIETY OF ARTS, at 8.—The Measurement of High Frequency Currents and Electric Waves: Prof. J. A. Fleming, F.R.S.

TUESDAY, DECEMBER 12.

ZOOLOGICAL SOCIETY, at 8.30.

FARADAY SOCIETY, at 8.—The Physics of Ore Flotation: J. Swinburne and Dr. G. Rudorf.—The Concentration of Metalliferous Sulphides by the Flotation Process: Prof. A. K. Huntington.—The Ions of Pure Water: Prof. J. Walker, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Adjourned Discussion*: The Steam-Turbine: Hon. C. A. Parsons, C.B., F.R.S., and G. G. Stoney.—

WEDNESDAY, DECEMBER 13.

SOCIETY OF ARTS, at 8.—The Commerce and Industries of Japan: W. F. Mitchell.

THURSDAY, DECEMBER 14.

ROYAL SOCIETY, at 4.30.—*Probable papers:* An Investigation into the Structure of the Lumbo-sacral-coccygeal Cord of the Macaque Monkey (*Macacus sinicus*): Miss M. P. Fitzgerald.—On the Distribution of Chlorides in Nerve Cells and Fibres: Prof. A. C. Macallum and Miss M. L. Menten.—The Mammalian Cerebral Cortex, with Special Reference to its Comparative Histology. I. Order Insectivora: Dr. G. A. Watson.—Observations on the Development of Ornithorhynchus: Prof. J. T. Wilson and Dr. J. P. Hill.—Further Work on the Development of the Hepatomonas of Kala-Azar and Cachexial Fever from Leishman-Donovan Bodies: Dr. L. Rogers.—The Action of Anæsthetics on Living Tissues. Part I. The Action on Isolated Nerve: N. H. Alcock.—Report on the Psychology and Sociology of the Todas and other Indian Tribes: an Abstract of Work carried out by the Aid of the Gunning Fund of the Royal Society for the year 1901-2: Dr. W. H. R. Rivers.—On the Sexuality and Development of the Ascocarp of *Humaria Granulata*, Quel.: V. H. Blackman and Miss Helen C. I. Fraser.—On the Microsporangia of the Pteridospermea with remarks on their Relationship to Existing Groups: Robert Kidston, F.R.S.—The Araucarieæ, Recent and Extinct: A. C. Seward, F.R.S., and Miss S. O. Ford.

MATHEMATICAL SOCIETY, at 5.30.—On Well-ordered Aggregates: Prof. A. C. Dixon.—Tables of Coefficients for Lagrange's Interpolation Formula: Col. R. L. Hippisley.—On the Representation of certain Asymptotic Series as Convergent Continued Fractions: Prof. L. J. Rogers.—On a New Cubic Connected with the Triangle: H. L. Trachtenberg.—Some Difficulties in the Theory of Transfinite Numbers and Order Types: Hon. B. A. W. Russell.—The Imaginary in Geometry: J. L. S. Hatton.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned Discussion*: The Charing Cross Company's City of London Works: W. H. Patchell

FRIDAY, DECEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Adjourned Discussion*: The Seventh Report to the Alloys Research Committee: On the Properties of a Series of Iron-Nickel-Manganese-Carbon Alloys: Dr. H. C. H. Carpenter, and Messrs. R. A. Hadfield and Percy Longmuir.—*Paper*: Behaviour of Materials of Construction under Pure Shear: E. G. Izod.

PHYSICAL SOCIETY (at Royal College of Science, South Kensington), at 7.—Exhibition of Electrical, Optical and other Physical Apparatus.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Tests of Street Illumination in Westminster: E. E. Mann.

AËRONAUTICAL SOCIETY, at 8.—The Acoustical Experiments carried out in Balloons by the late Rev. J. M. Bacon: Miss Gertrude Bacon.—The Aëromobile: F. Webb.—A New Continuous Impulse Petrol Motor for Dynamic Flying Machines: W. Cochrane.

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